EXAR

PRODUCT GUIDE
SHORT FORM

- USICs
- ASICs

TELECOMMUNICATIONS CIRCUITS

DATA COMMUNICATION & PERIPHERAL CIRCUITS

INDUSTRIAL CIRCUITS

INSTRUMENTATION & INTERFACE CIRCUITS

EXAR PRODUCT GUIDE SHORT FORM

Disclaimer

Exar reserves the right to make changes in the products contained in this book in order to improve design or performance and to supply the best possible products. Exar also assumes no responsibility for the use of any circuits described herein, conveys no license under any patent or other right, and makes no representations that the circuits are free from patent infringement. Applications for any integrated circuits contained in this publication are for illustration purposes only and Exar makes no representation or warranty that such applications will be suitable for the use specified without further testing or modification. Reproduction of any portion hereof without the prior written consent of Exar is prohibited.

First Printing - October 1986

750 Palomar Avenue
Sunnyvale, CA 94086
Telephone (408) 732-7970
TWX: 910-339-9233

PRODUCT GUIDE
SHORT FORM

EXAR Corporation 750 Palomar Avenue, Sunnyvale, California 94086

EXAR

Commitment to Excellence and Reliability

One of the founding principles of EXAR has been to provide our customers with unsurpassed service and quality. Today, every individual at EXAR has taken this principle as a personal commitment, assuring that quality and reliability are built into all our products from inception to realization.

For more than a decade, this commitment to excellence has allowed EXAR to establish itself as a dependable supplier to industry leaders in the telecommunications, data communications, computer peripherals, and industrial control markets. As an ASIC (Applications Specific Integrated Circuit) manufacturer, EXAR brings years of accumulated engineering expertise in the design of USIC (User Specific Integrated Circuit) for customers with unique requirements. EXAR's ASSP (Application Specific Standard Product), USIC and GPSP (General Purpose Standard Product), along with our linear and digital applications support, allow us to offer a total solution to your system requirements.

I am certain that our commitment and dedication to quality, technology, and service will develop an outstanding long term relationship with you, our valued customer.

Nob Hatta
President

TABLE OF CONTENTS

EXAR

Section 1—Cross References and Ordering Information

APPLICATION SPECIFIC STANDARD PRODUCTS (ASSP'S) CROSS REFERENCE

MODEMS - COMPETITION (NOT PIN COMPATIBLE UNLESS SPECIFIED)

EXAR Devices	AMI	Fairchild	Rockwell	Silicon Systems	Texas Instruments	Micro Power	Motorola	AMD
XR-212ACS	S35212A S35213	uA212A	R212DP	212A/103 SSI291 SSI213	TMS99532A TMS99534	MP7246 MP7247		AMDAC12
XR-212AS	S35212A S35213	uA212A	R212DP	212A/103 SSI291 SSI213	TMS99532A TMS995331	MP7246 MP7247		AMD79C12
XR-2123A						MP7253 (COMPATIBLE)		
XR-14412							MC14412 (COMPATIBLE)	

FILTERS (PIN COMPATIBLE)

EXAR Devices	AMI	Reticon	National	Maxim	Harris	Sierra	Mitel	
XR-2120								
XR-2103		5630/5631						
XR-1000/8			MF4-50/100					
XR-1010			MF10	MF10	MF10			
XR-2126	35212	5632/A				SC11000		
XR-2127	35212A	5632/B				SC11005		
XR-2128						SC11001		
XR-2129								

COMPUTER PERIPHERALS (PIN COMPATIBLE)

EXAR Devices	Motorola	Texas Instruments	Cherry	National	SSI			
XR-3470	MC3470	MC3470	CS3470					
XR-3471	MC3471	MC3471	CS3471					
XR-117			CS117					
XR-2247					SSI117			
XR-2917				LM2917				
XR-3447								
XR-3448			CS570*		SSI570*			
XR-3464				DP8464				

*Slight modification of PC board required, not an exact replacement

TELECOMMUNICATION PRODUCTS CROSS REFERENCE

TELECOMMUNICATION (PIN COMPATIBLE)

EXAR	Rohm	Mitel	Mostek	Sharp	Toshiba	PMI	Cherry	
XR-T8205	BA6565	MI8205			TA31002P		CS8205	
XR-T6425	BA6571							
XR-T5992	BU8992		MK50992	LR40992				
XR-T5990	BU6562							
XR-C277						RPT82		

Industry-wide Product Cross Reference

EXAR DEVICES	Fairchild	Intersil	Motorola	National	Raytheon	Signetics	Silicon General	Sprague	Texas Instruments
082 083 084									TL082 TL083 TL084
146 246 346 346-2				LM146 LM246 LM346 LM346-2	LM146 LM246 LM346				
494 495									TL494 TL495
555 L555 556 L556 558 559 567	UA555 UA556	NE555 NE556	MC1455 MC3456	LM555 LM556 LM567	RC555 RC556	NE555 NEL555 NE556 NEL556 NE558 NE559 NE567	SG555 SG556		SN72555
1310 1468 1488 1489A 1524 1525A 1527A 1543	 UA1488 UA1489		MC1310 MC1468 MC1488 MC1489A	LM1310 LM1488 LM1489A LM1524	 RC1488 RC1489A	MC1310 MC1488 MC1489A SG1524	 SG1468 SG1488 SG1489A SG1524 SG1525A SG2527A SG1543	ULN2110	SN76115N MC1488 SN75188 SN75189A SG1524
2001 2002 2003 2004 2011 2012 2013 2014	UA9665 UA9666 UA9668		MC1411 MC1412 MC1416			ULN2001 ULN2003 ULN2004	SG2001 SG2002 SG2003 SG2004 SG2011 SG2012 SG2013 SG2014	ULN2001 ULN2002 ULN2003 ULN2004 ULN2011 ULN2012 ULN2013 ULN2014	
2201 2202 2203 2204 2207 2211 2240	UA9665 UA9666 UA9667 UA9668 UA2240	 CL8240	MC1411 MC1412 MC1413 MC1416		 RC2207 RC2211	ULN2001 ULN2002 ULN2003 ULN2004	SG2001 SG2002 SG2003	ULN2001 ULN2002 ULN2003 ULN2004	ULN2001 SN75466 ULN2002 SN75467 ULN2003 SN75468 ULN2004 SN75469 UA2240
2524 2525A 2527A 2543 2567				LM2524	 RC2567	SG2524	SG2524 SG2525A SG2527A SG2543		
2917 3403 3470A 3471	UA3403		 MC3740A MC3471	LM2917	 RC3403				 MC3403 MC3470A MC3471
3503 3524 3525A 3527A 3543	UA3503			 LM3524	RC3503	 SG3524	SG3503 SG3524 SG3525A SG3527A SG3543		MC3503 SG3524
4136 4151 4194 4195	UA4136 UA4151				RC4136 RC4151 RC4194 RC4195		 SG4194		RC4136
4558 4739 4741	UA4558 UA739	 LM348	MC4558 MC4741	LM1458 LM348	RC4558 RC4739 IUA4741-5	MC1458	SG1458		RC4558 SN72558
5532 5533 5534					RC5532 RC5533 RC5534	NE5532 NE5533 NE5534			NE5532 NE5533 NE5534
6118 6128						NE594		ULN6118 ULN6128	
8038		ICL8038							
13600 14412			 MC14412	LM13600	LM13600	NE5517			

NUMERIC INDEX

PRODUCT ORDERING INFORMATION

Part Identification

XR
Manufacturer's Prefix

XXXXX
Basic Type

Grade

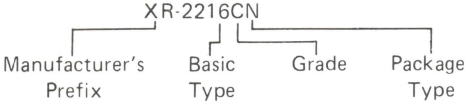
M = Military
N = Prime Electrical
P = Prime Electrical
C = Commercial
K = Kit

Package Type

N = Ceramic Dual-in-Line
P = Plastic Dual-in-Line
MD = Plastic SOIC**
Q = Quad Pack-Gullwing*
L = Leadless Chip Carrier*
J = Plastic Leaded Chip (PLCC J Lead)*

* Surface Mount Packages

Example



Definition of Symbols:

M = Military Grade Part, Ceramic Package Only. are guaranteed to operate over military temperature range. Consult factory for level of high rel screening.
N = Prime Grade Part, Ceramic Package
P = Prime Grade Part, Plastic Package
MD = Surface Mount, Plastic SOIC*
L = Leadless Chip Carrier (LCC)*
J = Plastic Leaded Chip Carrier Package (PLCC J Lead)*
Q = Quad Package - Gullwing*

N, P, CN and CP parts are electrically identical and operate over 0°C to +70°C unless otherwise stated. In addition, N and P parts generally have operating parameters more tightly controlled than the CN or CP parts.

For details, consult EXAR Sales Headquarters or your Sales/Technical Representatives.

ORDER ENTRY

EXAR Corporation
750 Palomar Avenue
PO Box 3575
Sunnyvale, CA 94088-3575

Phone: 408 732-7970
TWX: 910-339-9233 (EXAR SUVL)
FAX: 408-737-1635

EXAR

Section 2—Telecommunication Circuits

PCM Line Receiver & Clock Recovery Circuit

GENERAL DESCRIPTION

The XR-T5650 is a monolithic bipolar IC designed for PCM type line receiver applications operating at T1. T148C, T1C and 2 M bit/s data rates. It provides all the active circuitry required to perform automatic line build out (ALBO), threshold detection, positive and negative data and clock recovery.

Clock recover using a crystal filter instead of an LC tank circuit is also available as XR-T5750.

FEATURES

On Chip Positive and Negative Data, Clock Recovery
Less than 10 ns Sampling Pulse over the Operating Range
Double Matched ALBO Ports
Single 5.1 V Power Supply
2 M Bit/s Capability

APPLICATIONS

T1 PCM Line Receiver
T148C Line Receiver
T1C PCM Line Receiver (requires external amplifier)
General Purpose Bipolar Line Receiver
HDB3 Line Receiver
B8ZS Line Receiver

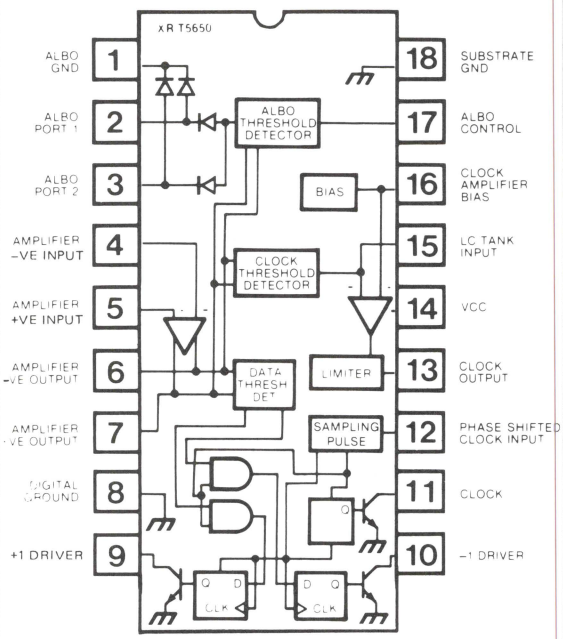
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40° to +85°C
Supply Voltage	-0.5 to +10 V
Supply Voltage Surge (10 ms)	+25 V
Input Voltage (except Pins 2,3,4,17)	-0.5 to 7 V
Input Voltage (Pins 2,3,4,17)	-0.5 to +0.5 V
Data Output Voltage (Pins 10,11)	20 V
Voltage Surge (Pins 5,6,10,11) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5650	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-T5650 is designed for interfacing T1, T148C and 2 Mbit/s PCM carrier lines on plastic or pulp insulated cables. It can also be used at T1C rate (3.152 M bit/s) with external gain. Since it outputs plus and minus ones on a bipolar pulse stream together with the clock, it can be used to interface systems having different line codes like AMI, AMI-B8ZS or AMI-HDB3.

The XR-T5650 is a modified version of XR-T5620 PCM repeater IC. It contains all the active circuitry needed to build a PCM line receiver up to 6300 ft. cable length. The preamplifier, the clock amplifier, threshold detectors, data latches and output drivers are similar to the ones on XR-T5620. Clock extraction is done by means of an LC tank circuit.

In addition to plus and minus one outputs, a synchronous clock signal is made available at Pin 11 by deleting one of the ALBO ports on XR-T5620 thus leaving two matched ALBO ports. All outputs have high current open collector transistors.

B8ZS/AMI Transcoder

GENERAL DESCRIPTION

The XR-T5670 is an LSI CMOS integrated circuit which performs the B8ZS or AMI transmission coding and receiving decoding functions with error detection. It is intended for DS1 (1.544 Mbits/s) PCM transmission applications, but can operate at clock frequencies up to 3.152 MHz. The device is packaged in a 16 Pin CERDIP package and the operating temperature is between -40°C to +85°C.

FEATURES

B8ZS Coding and Decoding for Data Rates
up to 3.152 Mbits/s to AT&T Technical Advisory 69
B8ZS/AMI Transmission Coding/Reception Decoding
with Code Error Detection
All Transmitter and Receiver Inputs/Outputs are
TTL Compatible
Internal Loop Test Capability
AIS (Alarm Indication Signal)
Single 5 V ± 10% Supply Rail

APPLICATIONS

AMI Encoding/Decoding
B8ZS Encoding/Decoding

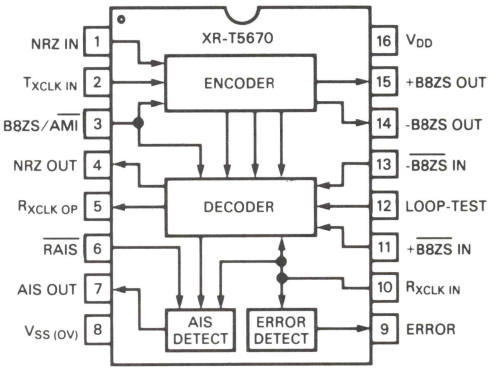
ABSOLUTE MAXIMUM RATINGS

DC Supply Voltage (V_{DD})	-0.3 to 7.0 V
Input Voltage Range (V_{IN})	-0.3 to V_{DD} + 0.3 V
Input Protection Current (I_D)	±10 mA
Storage Temperature Range	-55°C to 150°C
Operating Temperature Range	
Ceramic	-40°C to +85°C
Plastic	0°C to 70°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5670CP	Plastic	0°C to 70°C
XR-T5670CN	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

Coder

Binary data in "NRZIN" is clocked into the coder by a synchronous transmission clock "TXCLKIN" on the falling edge. The "+B8ZS" and "-B8ZS" output signals appear 8.5 clock cycles later to allow for the insertion of extra pulses due to sequences of eight consecutive zeros. These two signals are full width data and will be mixed with the "TX CLKIN" at the input of an external line driver to produce bipolar B8ZS signals for transmission.

Decoder

Received half width data on "+$\overline{\text{B8ZSIN}}$" and "-$\overline{\text{B8ZSIN}}$" are clocked into the decoder on the rising edge of the received clock "RXCLKIN". The "NRZOUT" binary data output occurs on eight clock cycles later. Input signals with bipolar violations which do not conform to the B8ZS coding rule are detected as errors. The error output "ERROR" is active high during one "RXCLKIN" clock period. The error output is not an accurate measure of error count, it is intended for alarm indication only.

AIS (Alarm Indication Signal)

If the decoder inputs received a continuous of ones (all marks) over two consecutive periods of the external reset signal "$\overline{\text{RAIS}}$", the "AISOUT" output will be set high and latched in that state until one or more zeros are received when the next reset signal "$\overline{\text{RAIS}}$" occurs.

The number of received zeros required to reset "AISOUT" over two consectuive periods of "$\overline{\text{RAIS}}$" can be mask programmed to two or three.

Dual Line Driver

GENERAL DESCRIPTION

The XR-T5675 is a bipolar monolithic dual line driver designed to drive PCM lines up to a 10 Mbits/s rate. The device is powered from a single 5 V ± 5% source. Its current consumption is 14 mA typical and the output can be pulled up to 20 V dc. The XR-T5675 is packaged in a standard 8 pin DIL plastic or ceramic package, and its temperature of operation is between 0°C to +70°C.

FEATURES

50 mA Output Drive Current Capability
Low Current Consumption (18 mA Max.)
High Speed Switching
Dual Matched Driver Outputs
High Output Voltage
TTL or DTL Compatible Inputs

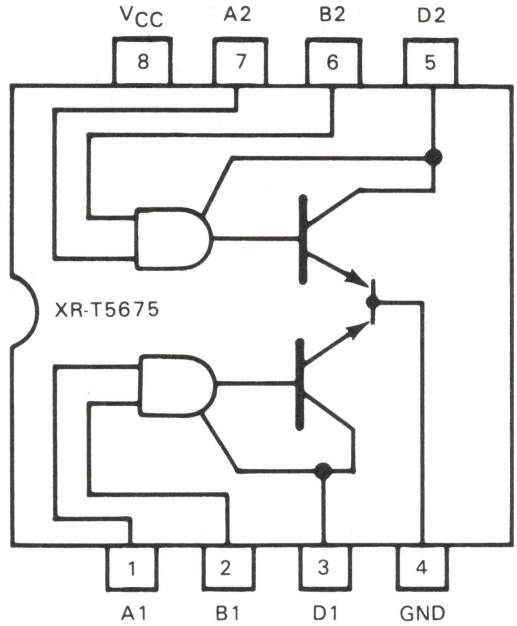
APPLICATIONS

T1, T1C, T2, 2048K and 8448K b/s PCM Line Driver
LAN Line Driver
Relay Driver
LED/Lamp Driver

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC})	+7.0 V
Input Voltage (Pin 1,2,6,7)	−0.2 V to +5.5 V
Output Pull-up Voltages (Pin 3,5)	25 V
Power Dissipation	
Ceramic	700 mW
Plastic	600 mW
Storage Temperature	−65°C to 150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5675CP	Plastic	0°C to +70°C
XR-T5675CN	Ceramic	0°C to +70°C

SYSTEM DESCRIPTION

Figure 1 contains the Functional Block Diagram of the XR-T5675. The circuit consists of two AND logic gates with their outputs internally connected to the bases of the output transistors. The low level outputs are clamped at 1 VBE to ground to insure non-saturating operation for fast switching.

A	B	OUTPUT (D)
L	L	H (OFF)
L	H	H (OFF)
H	L	H (OFF)
H	H	L (ON)

Truth Table - XR-T5675
H = H Level, L = Low Level

NOT RECOMMENDED FOR NEW DESIGNS SEE XR-T5683

PCM Line Interface Chip

GENERAL DESCRIPTION

The XR-T5680 is a PCM line interface chip. It consists of both transmit and receive circuitry in a DIL 18 pin package. The maximum bit rate the chip can handle is 10 M Bits/s and the signal level to the receiver can be attenuated by −10 dB cable loss at half the bit rate. Total current consumption is between 27-46 mA at +5.0 V.

FEATURES

Single +5.0 V Supply
Receiver Input Can Be Either Balanced or Unbalanced
Up to 10 MBits/s Operation
TTL Compatible Interface

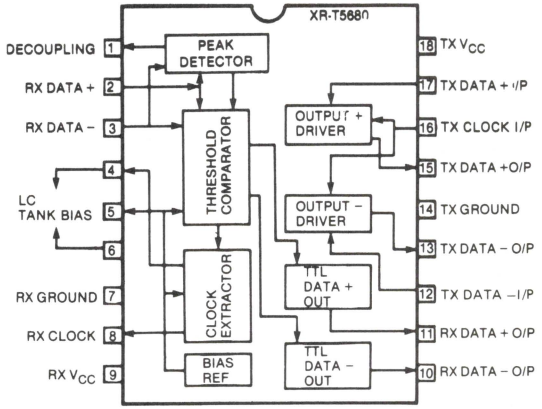
APPLICATIONS

T1, T1C, T148C, T2, 2048 & 8448 KBits/s
PCM Line Interface
CPI
DMI

ABSOULTE MAXIMUM RATINGS

Supply Voltage	+20 V
Storage Temperature	-65°C to +150°C
Operating Temperature	0°C to 70°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5680	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The incoming bipolar PCM signal which is attenuated and distorted by the cable is applied to the threshold comparator and the peak detector. The peak detector generates a DC reference for the threshold comparator for data and clock extraction. A tank circuit tuned to the appropriate frequency is added to the later operation. The clock signal, data + data − all go through a similar level shifter to be converted into TTL level to be compatible for digital processing.

In the transmit direction, the output drivers consist of two identical TTL inputs with open collector output stages. The maximum low level current these output stages can sink is 40.0 mA. With full width data applied to the inputs together with a synchronized clock. The output will generate a bipolar signal when driving a centre-tapped transformer. A typical circuit diagram to XR-T5680 is shown in Figure 1, and the DC characteristics are indicated in the Electrical Characteristics chart.

PCM Transceiver Chip

GENERAL DESCRIPTION

The XR-T5681 is a PCM transceiver chip. It consists of both transmit and receive circuitry in a CERDIP 18 pin package. The transceiver is designed for short line application (<—10 dB) such as in digital multiplexed interfacing and digital PBX environments. The maximum frequency of operation is 3 MBits/s so it covers T1, T148C, and Europe's 2.048 MBit/s PCM system. The device is designed to operate over the temperature range of 0°C to +70°C.

FEATURES

Single +5.0 V Supply
Receiver Can Accept Either Balanced or Unbalanced Inputs
TTL Compatible Interface
Transmitter and Receiver in One Package

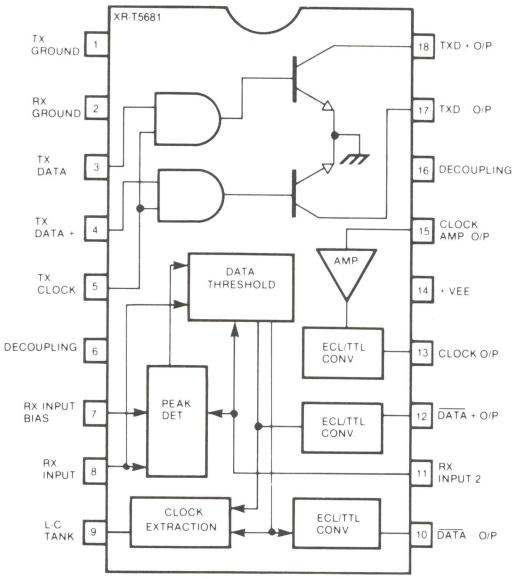
APPLICATIONS

T1, T148C, and 2.048 MBits/s PCM Line Interface
CPI
DMI

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	+20 V
Storage Temperature	-65°C to +150°C
Operating Temperature	0°C to 70°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5681	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The functions of the circuit terminals are defined in the Functional Block Diagram. At the receive direction, the incoming bipolar signal which has been attenuated and distorted by the cable is applied to the input of the peak detector. The variable threshold voltage produced by the peak detector controls the data comparator for P and N rails signal extractions. Timing information is obtained by means of a full wave rectifier and an L-C resonant circuit tuned at the appropriate frequency. All data and clock outputs are LSTTL compatible.

At the transmitter, the outputs have two identical non-saturating open collector stages which can drive the output line transformer directly with a maximum current of 40 mA. Full width, TTL compatible, P and N rail signals at the inputs and a 50% duty cycle TTL clock are needed to form the bipolar line signal at the secondary of the transformer. The output signal conforms to CCITT G.703 recommendation. A circuit diagram connected for 1.544 k bits/s line interface application is shown in Figure 1.

PCM Line Interface Chip

GENERAL DESCRIPTION

The XR-T5683 is a PCM line interface chip. It consists of both transmit and receive circuitry in a DIL 18 pin package. The maximum bit rate the chip can handle is 8.448 M Bits/s and the signal level to the receiver can be attenuated by −10 dB cable loss at half the bit rate. Total current consumption is between 27-46 mA at +5.0 V.

FEATURES

Single +5.0 V Supply
Receiver Input Can Be Either Balanced or Unbalanced
Up to 8.448 MBits/s Operation in Both
T_X and R_X Directions
TTL Compatible Interface

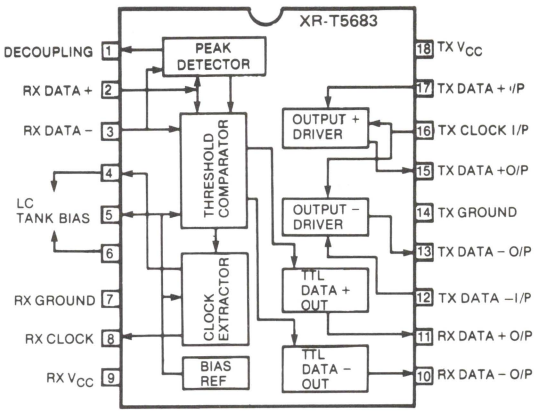
APPLICATIONS

T1, T148C, T2, 2048 & 8448 KBits/s
PCM Line Interface
CPI
DMI

ABSOULTE MAXIMUM RATINGS

Supply Voltage	+20 V
Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to 85°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5683	Ceramic	-40°C to +85°C

SYSTEM DESCRIPTION

The incoming bipolar PCM signal which is attenuated and distorted by the cable is applied to the threshold comparator and the peak detector. The peak detector generates a DC reference for the threshold comparator for data and clock extraction. A tank circuit tuned to the appropriate frequency is added to the later operation. The clock signal, data + data − all go through a similar level shifter to be converted into TTL level to be compatible for digital processing.

In the transmit direction, the output drivers consist of two identical TTL inputs with open collector output stages. The maximum low level current these output stages can sink is 40.0 mA. With full width data applied to the inputs together with a synchronized clock. The output will generate a bipolar signal when driving a centre-tapped transformer. A typical circuit diagram to XR-T5683 is shown in Figure 1, and the DC characteristics are indicated in the Electrical Characteristics chart.

PCM Line Receiver & Clock Recovery Circuit

GENERAL DESCRIPTION

The XR-T5750 is a monolithic bipolar IC designed for PCM line receiver applications operating at T1, T148C, T1C and 2 Mbit/s data rates. It provides all the active circuitry required to perform automatic line build out (ALBO), threshold detection, positive and negative data and clock recovery using a crystal filter.

Clock recovery using an LC tank circuit instead of a crystal filter is also available as XR-T5650.

FEATURES

On Chip Positive and Negative Data, Clock Recovery
Less than 10 ns Sampling Pulse Over the Operating Range
Double Matched ALBO Ports
Single 5.1 V Power Supply
2 M Bit/s Capability
Clock Recovery using Crystal Filter

APPLICATIONS

T1 PCM Line Receiver
T148C LIne Receiver
T1C PCM Line Receiver (requires external amplifier)
General Purpose Bipolar Line Receiver
HDB3 Line Receiver
B8ZS Line Receiver

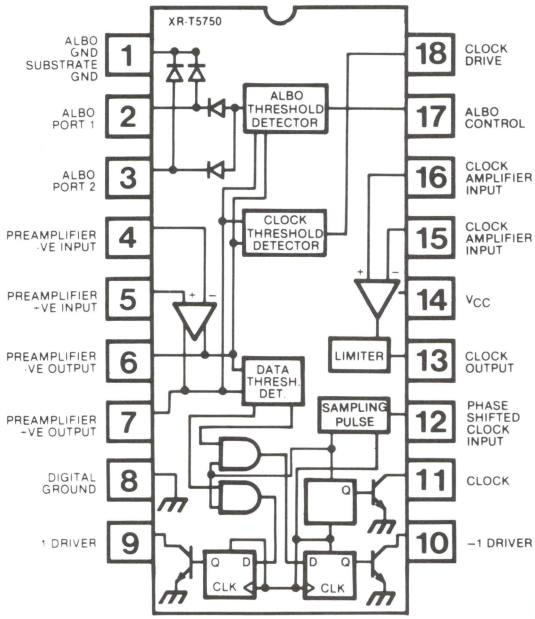
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Supply Voltage Surge (10 ms)	+25 V
Input Voltage (except Pins 2,3,4,17)	-0.5 to 7 V
Input Voltage (Pins 2,3,4,17)	-0.5 to +0.5 V
Data Output Voltage (Pins 10,11)	20 V
Voltage Surge (Pins 5,6,10,11) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5750	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-T5750 is designed for interfacing T1, T148C and 2 Mbit/s PCM carrier lines on plastic or pulp insulated cables. It can also be used at T1C rate (3.152 M bit/s) with external gain. Since it outputs plus and minus ones on a bipolar pulse stream together with the clock, it can be used to interface systems having different line codes like AMI, AMI-B8ZS or AMI-HDB3.

The XR-T5750 is a modified version of XR-T5720 PCM repeater IC. It contains all the active circuitry needed to build a PCM line receiver up to 6300 ft. cable length. The preamplifier, the clock amplifier, threshold detectors, data latches and output drivers are similar to the ones on XR-T5720. Clock extraction is done by means of a crystal filter circuit.

In addition to plus and minus one outputs, a synchronous clock signal is made available at Pin 11 by deleting one of the ALBO ports on XR-T5720 thus leaving two matched ALBO ports. All outputs have high current open collector transistors.

High Speed Digital Loop Tranceivers

PRELIMINARY DATA SHEET

GENERAL DESCRIPTION

The XR-T6000/T6010 are high speed data transceivers. They provide 256 KBits/s duplex data communication over 26 AWG twisted pair cable up to 10K feet in distance.

Intended primarily for use in digital subscriber voice/data telephone systems, they can also be used in limited distance base band modem, remote data acquisitions, and control systems.

FEATURES

Loop Back Mode
Single 5 Volt Supply
256 KBits/s Transmission Capability
Adaptive Equalization
Variable Data Clock Rate
Bipolar Line Coding
Automatic Detection Threshold Adjustment for Optimum Performance Over Varying Signal Attenuations

APPLICATIONS

ISDN Reference Point S and T Interface
2 Wire TCM / Digital Subscriber Loop Interface
4 Wire Full Duplex Base Band Modems

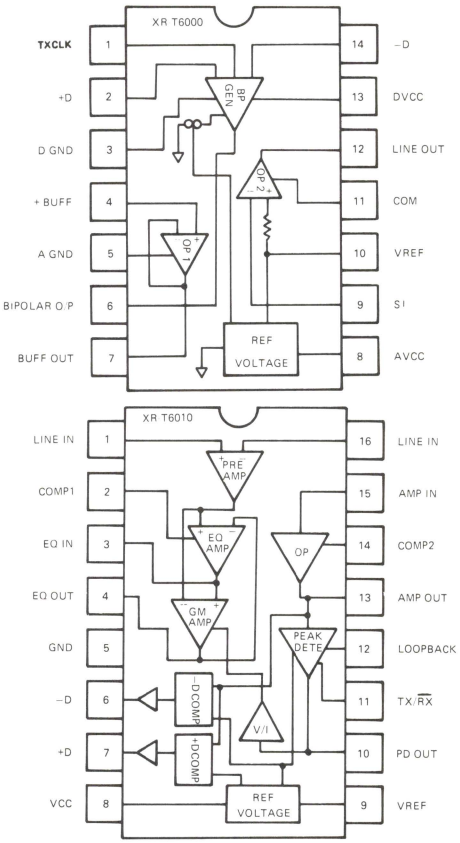
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−65°C to 150°C
Operating Temperature	0°C to 70°C
Supply Voltage (V_{CC})	7 Volts
Input Voltages	GND to V_{CC}

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6000CN	Ceramic	0°C to 70°C
XR-T6010CN	Ceramic	0°C to 70°C
XR-T6000CP	Plastic	0°C to 70°C
XR-T6010CP	Plastic	0°C to 70°C

FUNCTIONAL BLOCK DIAGRAMS



SYSTEM DESCRIPTION

The XR-T6000 Line Driver and the XR-T6010 Line Receiver are line termination circuits for Burst Mode (also referred to as ping pong transmission) or Bidirectional 4 wire digital loop subscriber.

The XR-T6000/T6010 are intended primarily for digital subscriber line interface or local office application at the customer's premises interfacing with the terminal or the local exchange equipment.

The XR-T6010 Line Receiver, capable of operating from 4 KBits/s to 256 KBits/s transmission rates, contains most of the active circuits necessary for differential to single ended conversion, adaptive equalization, and signal demodulation functions with minimal external components.

Section 2—Telecommunication Circuits

Monolithic PCM Repeater

GENERAL DESCRIPTION

The XR-C240 is a monolithic repeater circuit for Pulse-Code Modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rate on T1-type PCM lines.

The XR-C240 monolithic IC is packaged in a hermetic 16-Pin DIP package, and is designed to operate over a temperature range of -40°C to +85°C. It contains all the basic functional blocks of a regenerative repeater system including Automatic Line Build-Out (ALBO) and equalization, and is insensitive to reflections caused by cable discontinuities.

Compared to conventional repeater designs using discrete components, the XR-C240 monolithic repeater IC offers greatly improved reliability and performance, along with significant savings in power consumption and system cost.

FEATURES

Contains all Active Components of PCM Repeater
On-Chip ALBO Port
High-Current Output Drivers
Low-Power Consumption
Increased Reliability over Discrete Designs
2 Megabit Operation Capability

APPLICATIONS

PCM Repeater for T1 Systems
PCM Repeater for 2 M Bit/s Systems

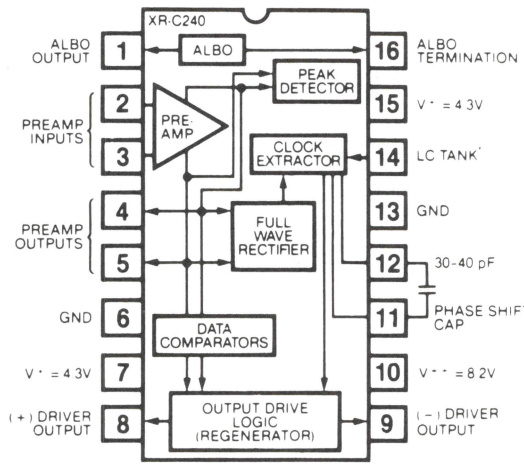
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to 10 V
Input Voltage (Except Pin 1,16)	-0.5 to +7 V
Input Voltage (Pin 7,16)	-0.5 to +0.5 V
Data Output Voltage (Pin 8,9)	+20 V
Voltage Surge (Pin 2,3,8,9) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-C240	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-C240 contains all the active circuits required to build one side of a T1 or 2 M bit/s PCM repeater. T1 is the most widely used PCM transmission system, operating at 1.544 M bit/s. It can operate on either pulp or plastic insulated twisted pair cables. Although the cable gauge may vary, the total cable loss should not exceed 36 dB at 772 kHz. For a 22 gauge pulp insulated cable and a bit error rate (BER) of less than 10^{-6}, the max allowable repeater to repeater spacing is about 6300 feet.

Bipolar PCM signal is attenuated and dispersed in time as it travels along a transmission cable. This signal, when received, is amplified and reconstructed by the preamplifier automatic line build out (ABLO), clock and data threshold detector circuits contained within the XR-C240. Amplitude equalization and frequency spectrum shaping is achieved through the variable impedance of the ALBO ports and its associated ALBO network.

Incoming pulse stream is full wave rectified and timing information is extracted by the clock threshold detector. Clock recovery is then achieved by driving an injection locked oscillator tuned to 1.544 MHz. The oscillator's sinusoidal waveform is amplified and phase shifted by 90 degrees with the help of a capacitor between Pins 11 and 12.

Data is sampled and stored in the output data latches by an internally generated sampling pulse. Buffer drivers are then enabled to produce precisely timed output pulses whose width and time of occurence are controlled by the regenerated clock signal.

High-Performance PCM Repeater

GENERAL DESCRIPTION

The XR-C262 is a high-performance monolithic repeater IC for pulse-code modulated (PCM) telephone lines. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rates on T1-type PCM lines.

The XR-C262 operates with a single 6.8 volt power supply, and with a typical supply current of 13 mA. It provides bipolar output drive with high-current handling capability. The clock-extractor section of XR-C262 uses the resonant-tank circuit principle, rather than the injection-locked oscillator technique used in earlier monolithic repeater designs. The bipolar output drivers are designed to go to their "off" state automatically, when there is no input signal present.

FEATURES

Contains all Necessary Active Components of a PCM Repeater
Uses L-C Tank for Clock Recovery
Low-Voltage Operation (6.8 volts)
Low-Current Drain (13 mA, typical)
High-Current Bipolar Output Drivers
On-Chip ALBO Equalizer
Automatic Zero-Input Shutdown
Increased Reliability Over Discrete Designs
2 Megabit Operation Capability

APPLICATIONS

PCM Repeater for T1 Systems
Repeater for 2 Megabit PCM Systems

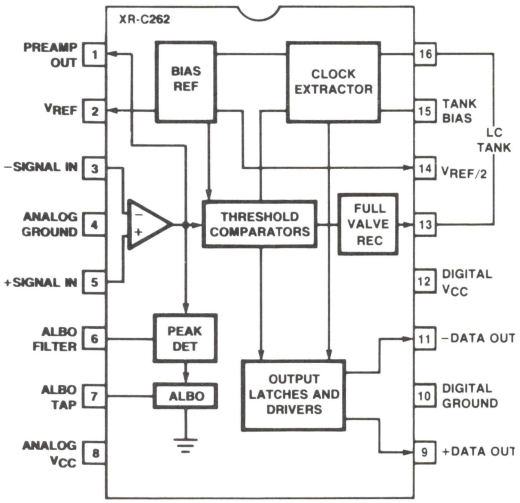
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−65°C to +150°C
Operating Temperature	−40°C to +85°C
Supply Voltage	−0.5 to +10 V
Input Voltage (Except Pin 6,7)	−0.5 to +7 V
Input Voltage (Pin 6,7)	−0.5 to +0.5 V
Data Output Voltage (Pin 9,11)	+20 V
Voltage Surge (Pin 3,5,9,11) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-C262	Ceramic	−40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-C262 contains all the active functions required to build one side of a T1 or 2 M bit/s PCM repeater. T1 is the most widely used PCM transmission system, operating at 1.544 M bit/s. It can operate on either pulp or plastic insulated twisted pair cables. Although the cable gauge may vary, the total cable loss should not exceed 36 dB at 772 kHz. For a 22 gauge pulp insulated cable and a bit error rate (BER) of less than 10^{-6}, the max allowable repeater to repeater spacing is about 6300 feet.

Bipolar PCM signal is attenuated and dispersed in time as it travels along a transmission cable. This signal, when received, is amplified and reconstructed by the peamplifier automatic line build out (ALBO), clock and data threshold detector circuits contained within the XR-C262. Amplitude equalization and frequency spectrum shaping is achieved through the variable impedance of the ALBO port and its associated ALBO network.

Incoming pulse stream is full wave rectified and timing information is extracted by the clock threshold detector. Clock recovery is then achieved by pulsing a tank circuit tuned to 1.544 MHz.

Data is sampled and stored in the output data latches. Buffer drivers are then enabled to produce precisely timed output pulses whose width and time of occurrence are controlled by the regenerated clock signal.

High-Performance PCM Repeater

GENERAL DESCRIPTION

The XR-C262Z is a high-performance monolithic repeater IC for pulse-code modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rate on T1-type PCM lines.

The XR-C262Z operates with a single 6.8 volt power supply, and with a typical supply current of 13 mA. It provides bipolar output drive with high-current handling capability. The clock-extractor section of XR-C262Z uses the resonant-tank circuit principle, rather than the injection-locked oscillator technique used in earlier monolithic repeater designs. The bipolar output drivers are designed to go to their "off" state automatically, when there is no input signal present.

FEATURES

Contains all Necessary Active Components of a PCM Repeater
Uses L-C Tank for Clock Recovery
Low-Voltage Operation (6.8 volts)
Low-Current Drain (13 mA, typical)
High-Current Bipolar Output Drivers
On-Chip ALBO Port
Automatic Zero-Input Shutdown
Increased Reliability Over Discrete Designs
2 Megabit Operation Capability
Pin-to-Pin Compatible with XR-C262 with Improved Switching Characteristics

APPLICATIONS

PCM Repeater for T1 Systems
PCM Repeater for 2 M Bit/s Systems

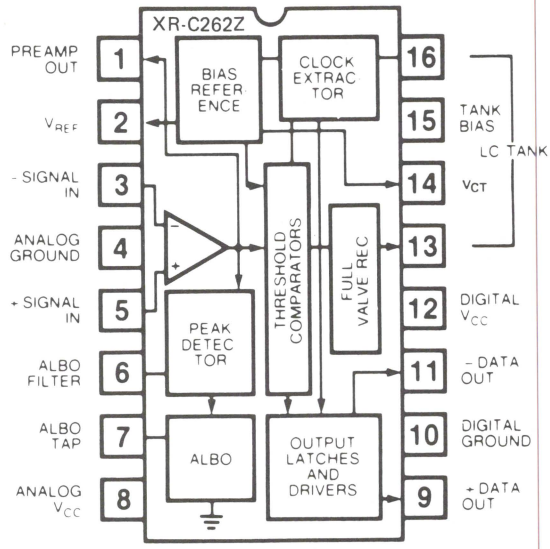
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Input Voltage (Except Pin 6,7)	-0.5 to +7 V
Input Voltage (Pin 6,7)	-0.5 to +0.5 V
Data Output Voltage (Pin 9,11)	+20 V
Voltage Surge (Pin 3,5,9,11) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-C262Z	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-C262Z contains all the active functions required to build one side of a T1 or 2 M bit/s PCM repeater. T1 is the most widely used PCM transmission system, operating at 1.544 M bit/s. It can operate on either pulp or plastic insulated twisted pair cables. Although the cable gauge may vary, the total cable loss should not exceed 36 dB at 772 kHz. For a 22 gauge pulp insulated cable and a bit error rate (BER) of less than 10^{-6}, the max allowable repeater to repeater spacing is about 6300 feet.

Bipolar PCM signal is attenuated and dispersed in time as it travels along a transmission cable. This signal, when received, is amplified and reconstructed by the preamplifier automatic line build out (ALBO), clock and data threshold detector circuits contained within the XR-C262Z. Amplitude equalization and frequency spectrum shaping is achieved through the variable impedance of the ALBO ports and its associated ALBO network.

Incoming pulse stream is full wave rectified and timing information is extracted by the clock threshold detector. Clock recovery is then achieved by pulsing a tank circuit tuned to 1.544 MHz.

Data is sampled and stored in the output data latches. Buffer drivers are then enabled to produce precisely timed output pulses whose width and time of occurence are controlled by the regenerated clock signal.

Low-Voltage PCM Repeater

GENERAL DESCRIPTION

The XR-C277 is a monolithic repeater circuit for Pulse-Code Modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rate on T1-type PCM lines. It is packaged in a hermetic 16-Pin CERDIP package and is designed to operate over a temperature range of -40°C to +85°C. It contains all the basic functional blocks of a regenerative repeater system, including Automatic Line Build-Out (ALBO) and equalization, and is insensitive to reflections caused by cable discontinuities.

The key feature of the XR-C277 is its ability to operate with low supply voltage (6.3 volts and 4.3 volts) with a supply current of less than 13 mA. Compared to conventional repeater designs using discrete components, the XR-C277 monolithic repeater IC offers greatly improved reliability and performance, along with significant savings in power consumption and system cost.

The XR-C277-5F is an improved version of XR-C277 with an internal feedback that improved the phase gain margin which enables the system to be more stable and less sensitive to PC board layouts.

Other versions of the XR-C277-5F are XR-C277-F and XR-C277-FL. XR-C277-F is an AC tested device of XR-C277-5F at 2Mbit while XR-C277-FL is the equivalen at 1.544 Mbit.

FEATURES

Contains all the Active Components of a PCM Repeater
Low-Voltage Operation (6.3 volts)
Low-Power Dissipation (13 mA)
On-Chip ALBO Port
High-Current Output Drivers
Increased Reliability over Discrete Designs
2 Megabit Operation Capability
Pin-Compatible with XR-C240

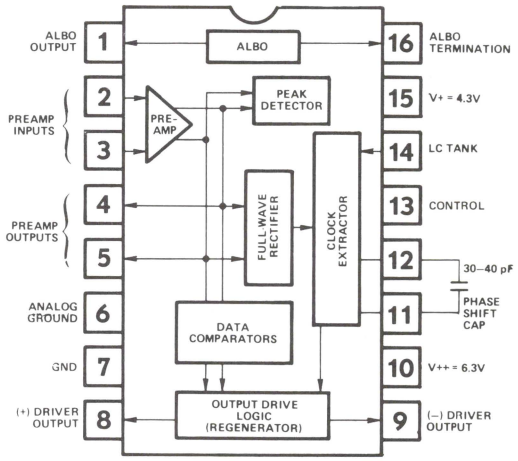
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Input Voltage (Except Pin 1,16)	-0.5 to +7 V
Input Voltage (Pin 1,16)	-0.5 to +0.5 V
Data Output Voltage (Pin 8,9)	20 V
Voltage Surge (Pin 2,3,8,9) (10 msec only)	50 V

SYSTEM DESCRIPTION

The XR-C277 contains all the active circuits required to build one side of a T1 or 2 M bit/s PCM repeater. T1 is the most widely used PCM transmission system, operating at 1.544 M bit/s. It can operate on either pulp or plastic insulated twisted pair cables. Although the cable gauge may vary the total cable loss should not exceed 36 dB at 772 kHz. For a 22 gauge pulp insulated cable and a bit error rate (BER) of less than 10-6 the max allowable repeater to repeater spacing is about 6300 feet.

FUNCTIONAL BLOCK DIAGRAM



Bipolar PCM signal is attenuated and dispersed in time as it travels along a transmission cable. This signal, when received, is amplified and reconstructed by the preamplifier automatic line build out (ALBO), clock and data threshold detector circuits contained within the XR-C277. Amplitude equalization and frequency spectrum shaping is achieved through the variable impedance of the ALBO port and its associated ALBO network.

Incoming pulse stream is full wave rectified and timing information is extracted by the clock threshold detector. Clock recovery is then achieved by pulsing a tank circuit tuned to 1.544 MHz. Either injection locking or pulsed tank type clock extraction are possible with the XR-C277. By grounding Pin 13, the circuit works in the injection lock mode. Floating (open) Pin 13 switches the XR-C277 to an pulse tank mode. The oscillator's sinusoidal waveform is amplified and phase shifted by 90 degrees with the help of a capacitor between Pins 11 and 12.

Data is sampled and stored in the output data latches by an internally generated sampling pulse. Buffer drivers are then enabled to produce precisely timed output pulses whose width and time of occurence are controlled by the regenerated clock signal.

Low Voltage PCM Repeater

GENERAL DESCRIPTION

The XR-T445B is a monolithic repeater circuit for Pulse-Code Modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rate on T1-type PCM lines. It is packaged in a hermetic 16-Pin CERDIP package and is designed to operate over a temperature range of -40°C to +85°C. It contains all the basic functional blocks of a regenerative repeater system, including Automatic Line Build-Out (ALBO) and equalization, and is insensitive to reflections caused by cable discontinuities.

The key feature of the XR-T445B is its ability to operate with low supply voltage (6.3 volts and 4.3 volts) with a supply current of less than 13 mA. Compared to conventional repeater designs using discrete components, the XR-T445B monolithic repeater IC offers greatly improved reliability and performance, along with significant savings in power consumption and system cost.

FEATURES

Contains all the Active Components of a PCM Repeater
Low-Voltage Operation (6.3 volts)
Low-Power Dissipation (13 mA)
On-Chip ALBO Port
High-Current Output Drivers
Increased Reliability over Discrete Designs
2 Megabit Operation Capability
Improved Layout Sensitivity

APPLICATIONS

PCM Repeater for T1 Systems
PCM Repeater for 2 M Bit/s Systems

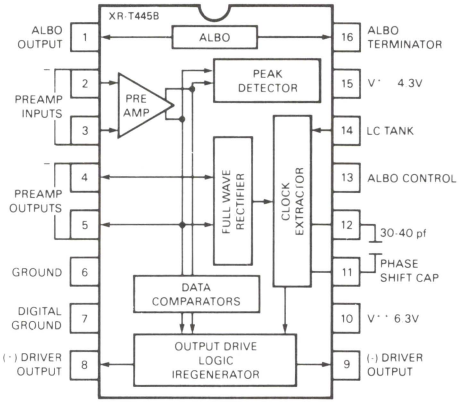
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Input Voltage (Except Pin 1,16)	-0.5 to +7 V
Input Voltage (Pin 1,16)	-0.5 to +0.5 V
Data Output Voltage (Pin 8,9)	20 V
Voltage Surge (Pin 2,3,8,9) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T445B	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-T445B contains all the active circuits required to build one side of a T1 or 2 M bit/s PCM repeater. T1 is the most widely used PCM transmission system, operating at 1.544 M bit/s. It can operate on either pulp or plastic insulated twisted pair cables. Although the cable gauge may vary the total cable loss should not exceed 36 dB at 772 kHz. For a 22 gauge pulp insulated cable and a bit error rate (BER) of less than 10^{-6} the max allowable repeater to repeater spacing is about 6300 feet.

Bipolar PCM signal is attenuated and dispersed in time as it travels along a transmission cable. This signal, when received, is amplified and reconstructed by the preamplifier automatic line build out (ALBO), clock and data threshold detector circuits contained within the XR-T445B Amplitude equalization and frequency spectrum shaping is achieved through the variable impedance of the ALBO port and its associated ALBO network.

Incoming pulse stream is full wave rectified and timing information is extracted by the clock threshold detector. Clock recovery is then achieved by pulsing a tank circuit tuned to 1.544 MHz. Either injection locking or pulsed tank type clock extraction are possible with the XR-T445B. By grounding Pin 13, the circuit works in the pulsed tank mode. Floating (open) Pin 13 switches the XR-T445B to an injection locked mode. The oscillator's sinusoidal waveform is amplified and phase shifted by 90 degrees with the help of a capacitor between Pins 11 and 12.

Data is sampled and stored in the output data latches by an internally generated sampling pulse. Buffer drivers are then enabled to produce precisely timed output pulses whose width and time of occurence are controlled by the regenerated clock signal.

T1C PCM Repeater Chip Set

GENERAL DESCRIPTION

The IC pair, XR-C587 and XR-C588, provides all the active circuitry needed to form one side of a T1C PCM Repeater (3.152 MBits/sec). Each chip is packaged in a 16-Pin CERDIP package, with an operating temperature range of -40°C to +85°C. The supply voltage range is 6.0 to 6.8 V_{DC}, with a typical supply current for the pair of 16 mA.

The XR-C587 contains an amplifier, three ALBO ports, and an npn transistor. The amplifier is a modified version of the amplifier in Exar's XR-C262 T1 repeater chip. This amplifier has its own ground pin for isolation, as well as for eliminating the amplifier current drain if only the XR-C587 ALBO diodes and/or the transistor are used. Each of the three ALBO ports has a separate ground and one common drive input. Any number, up to three, can be used while eliminating current in any not used. The npn transistor is provided for incidental uses.

The XR-C588 contains a preamplifier, an ALBO drive output, a voltage reference, comparators, a clock recovery circuit, ECL latches and two output drivers. The XR-C588 is a modified version of XR-C262 for T1C performance. The amplifiers in the XR-C587 and XR-C588 are the same. The clock driver output is modified to drive a crystal and has higher gain. Both inputs to the clock amplifier are available. The clock amplifier may be biased, both from the center tap voltage (Pin 14), and the clock bias voltage (Pin 7).

Two options for the clock comparator threshold voltage are provided. Option 1 is 65% of ALBO threshold, and Option 2 is 50% (the same as C262).

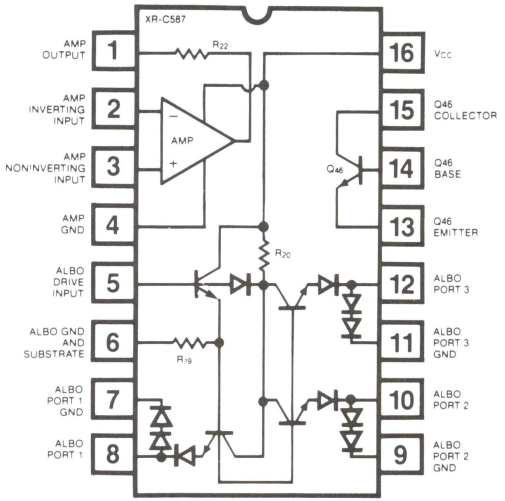
FEATURES

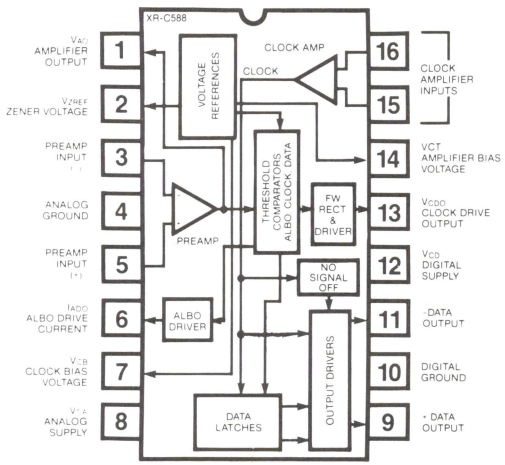
Modified Preamplifier with Improved Phase Margin
Separate Grounds for Preamplifier and ALBO Ports
Crystal Drive Capability for High Q Operation
Optional Clock Comparator Threshold Levels (50% & 65%)

ABSOLUTE MAXIMUM RATINGS

Analog Supply Voltage	-0.5V to 10V
Digital Supply Voltage	-0.5V to 10V
Differential Input Voltage	-5V to 5V
Output Voltage	-0.5V to 20V
Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Lead Soldering (10 seconds)	300°C

FUNCTIONAL BLOCK DIAGRAMS





ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-C587	Ceramic	-45°C to +85°C
XR-C588	Ceramic	-45°C to +85°C

T1, T148C, & 2 M Bit/s PCM Line Repeater

GENERAL DESCRIPTION

The XR-T5600/T5620 is a bipolar monolithic repeater IC designed for PCM carrier systems operating at 1.544 M bit/s (T1), 2 M bit/s, or 2.37 M bit/s (T148C). It provides all of the active circuits required for one side of a PCM repeater. A crystal filter clock extraction version of XR-T5600/T5620 is available as XR-T5700/T5720.

FEATURES

Single 5.1 V Power Supply
Less than 10 ns Sampling Pulse over the Operating Range
Triple Matched ALBO Ports
2 M Bit/s Capability

APPLICATIONS

T1 PCM Repeater
T148C PCM Repeater
European 2 M Bit/s PCM Repeater
T1C PCM Repeater (requires external preamplifier)

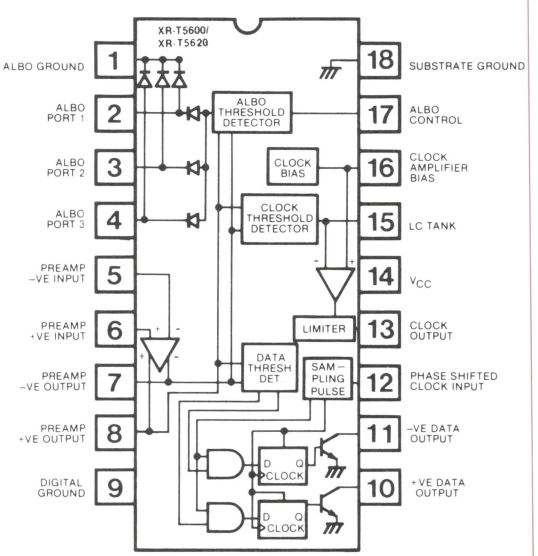
ORDERING INFORMATION

Part Number	Package	Operation Temperature
XR-T5600	Plastic	−40°C to 85°C
XR-T5620	Plastic or Ceramic	−40°C to 85°C

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Supply Voltage Surge (10 ms)	+25 V
Input Voltage (except Pin 2,3,4,17)	-0.5 to 7 V
Input Voltage (Pin 2,3,4,17)	-0.5 to +0.5 V
Data Output Voltage (Pin 10, 11)	20 V
Voltage Surge (Pin 5,6,10,11) (10 msec only)	50 V

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-T5600/T5620 performs most of the functions required for one side of a PCM repeater operating at 2 M bit/s or similar baud rate. The integrated circuit amplifies the received positive and negative pulses and feeds them into Automatic Line Build-out (ALBO), clock and data threshold detectors, see Figure 1. The ALBO threshold detector ensures that the received pulses at Pins 7 and 8 have the correct amplitude and shape. This is carried out by controlling the gain and frequency shaping of the ALBO network with three variable impedance ALBO ports.

The clock threshold detector extracts timing information from the pulses received at Pins 7 and 8 and passes it into the external tank coil at Pin 15. The sinusoidal-type waveform is amplified into a square wave at Pin 13, and forwarded through an external phase shift network into Pin 12. This waveform provides the data sampling pulse which opens latches into which the data from the data threshold detectors is passed. The resulting pulses are stored for half a bit period (normally 488 ns) in the latches. They appear as half-width output pulses at Pins 10 and 11.

T1, T148C & 2 Mbits/s PCM Line Repeater

GENERAL DESCRIPTION

The XR-T5720 is a bipolar monolithic repeater IC that provides all the active circuits required for one side of a PCM repeater. The IC is designed for clock extraction by using a crystal filter.

The primary application of the XR-T5720 is T1 (1.544 M bit/s), and European 2 M bit/s PCM repeater.

A tank circuit clock extraction version of the XR-T5720 is available as XR-T5600/5620.

FEATURES

Crystal Clock Extraction
Single 5.1 V Power Supply
Less than 10 ns Sampling Pulse over the Operating Range
Triple Matched ALBO Ports

APPLICATIONS

T1 PCM Repeater
T148C PCM Repeater
T1C PCM Repeater (requires external preamplifier)
European 2 M Bit/s PCM Repeater

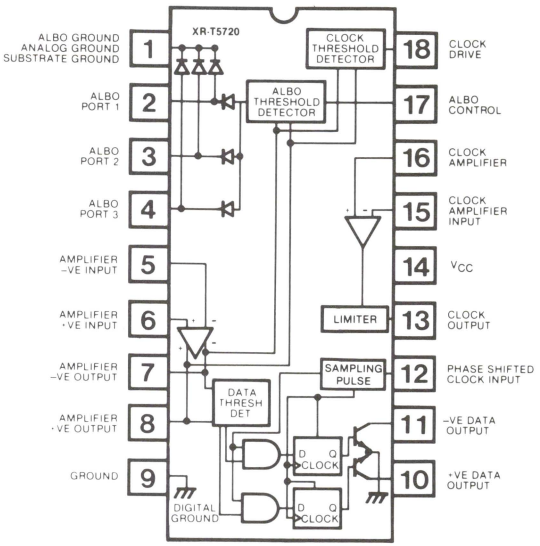
ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	-40°C to +85°C
Supply Voltage	-0.5 to +10 V
Supply Voltage Surge (10 ms)	+25 V
Input Voltage(except Pins 2,3,4,17)	-0.5 to 7 V
Input Voltage (Pins 2,3,4,17)	-0.5 to +0.5 V
Data Output Voltage (Pins 10, 11)	20 V
Voltage Surge (Pins 5,6,10,11) (10 msec only)	50 V

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5720	Ceramic	-40°C to +85°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-T5720 performs most of the functions required for one side of a PCM repeater operating at 2 M bit/s or similar baud rate. The integrated circuit amplifies the received positive and negative pulses and feeds them into Automatic Line Build-out (ALBO), clock and data threshold detectors, see Figure 1. The ALBO threshold detector ensures that the received pulses at Pins 7 and 8 have the correct amplitude and shape. This is carried out by controlling the gain and frequency shaping of the ALBO network with three variable impedance ALBO ports.

The clock threshold detector extracts timing information from the pulses received at Pins 7 and 8 and passes it into open collector Pin 18. A crystal filter is connected from Pin 18 to clock amplifier input Pins 16 and 15. The sinusoidal-type waveform is amplified into a square wave at Pin 13, and forwarded through an external phase shift network into Pin 12. This waveform provides the data sampling pulse which opens latches into which the data from the data threshold detectors is passed. The resulting pulses are stored for half a bit period (normally 488 ns for 2 M bit/s) in the latches. They appear as half-width output pulses at Pins 10 and 11.

Section 2—Telecommunication Circuits

Speakerphone Audio Circuit

GENERAL DESCRIPTION

The XR-T6420-1 is a monolithic integrated circuit for use in high performance speakerphone systems. It is designed to be used with the XR-T6421 Speakerphone Control Circuit.

The XR-T6420-1 contains the audio paths comprising the following: Two variable gain cells, a microphone amplifier, a transmitting amplifier, a receive amplifier, and a speaker amplifier.

FEATURES

Two Matched Variable Gain Cells
Internal Microphone Amplifier
Independent Control of Transmitting and Receiving Levels
External Control of Gains and Frequency Response

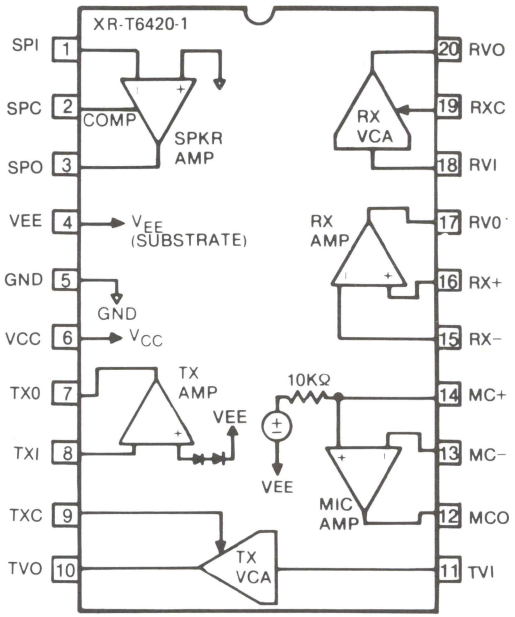
APPLICATIONS

Speakerphones
Intercoms
Voltage Controlled Amplifiers

ABSOLUTE MAXIMUM RATINGS/

Power Supply ($V_{CC} - V_{EE}$)	+20 V
Power Dissipation	1 W
Derate Above +25°C	7 mW/°C
Operating Temperature	0°C to 70°C
Any Input Voltage	V_{CC} – 0.5 V to V_{EE} + 0.5 V
Storage Temperature	-55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6420-1CN	Ceramic	0°C to 70°C
XR-T6420-1CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The speakerphone concept essentially requires that only one direction of sound transmission be permitted at any time. This restraint is brought about by the large gains required to provide loudspeaker volume and high microphone sensitivity. Owing to the inevitable acoustic coupling between loudspeaker and microphone, plus imperfections in the hybrid 2 to 4 wire conversion, it is necessary to lower the gain in either the transmitting or receiving path at any one time to avoid regeneration.

The XR-T6420-1 and XR-T6421 chip set enables the system designer to make a highly adaptive, high performance speakerphone. The XR-T6421 provides for all sensing and control functions, while the XR-T6420-1 contains all audio paths needed to switch the gain in either path and provide interfacing between the system and line.

Speakerphone Audio Circuit

GENERAL DESCRIPTION

The XR-T6420-2 is a monolithic integrated circuit for use in high performance speakerphone systems. It is designed to be used with the XR-T6421 Speakerphone Control Circuit.

The XR-T6420-2 contains the audio paths comprising the following: Two variable gain cells, a microphone amplifier, a transmitting amplifier, a receive amplifier, and a speaker amplifier. Mute and enable control logic of the variable gains cells is provided internally.

FEATURES

Two Matched Variable Gain Cells
Internal Microphone Amplifier
Independent Control of Transmitting and Receiving Levels
External Control of Gains and Frequency Response
Enable and Mute Logic Pins

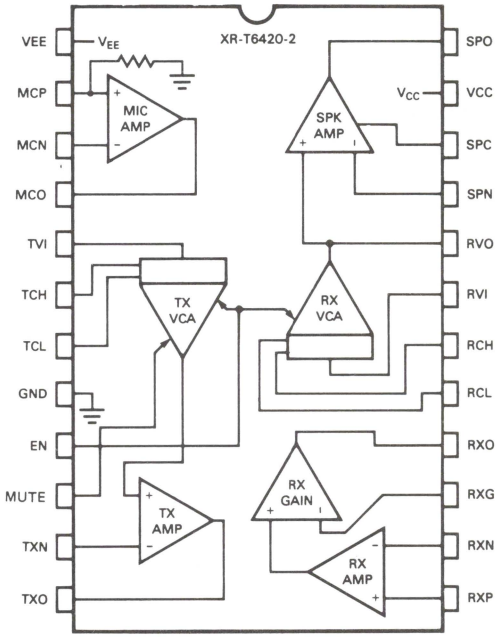
APPLICATIONS

Speakerphones
Intercoms
Voltage Controlled Amplifiers

ABSOLUTE MAXIMUM RATINGS

Power Supply ($V_{CC} - V_{EE}$)	+30 V
Power Dissipation	1 W
Derate Above +25°C	7 mW/°C
Operating Temperature	0°C to 70°C
Any Input Voltage	V_{CC} – 0.5 V to V_{EE} + 0.5 V
Storage Temperature	-55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6420-2CN	Ceramic	0°C to 70°C
XR-T6420-2CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The speakerphone concept essentially requires that only one direction of sound transmission be permitted at any time. This restraint is brought about by the large gains required to provide loudspeaker volume and high microphone sensitivity. Owing to the inevitable acoustic coupling between loudspeaker and microphone, plus imperfections in the hybrid 2 to 4 wire conversion, it is necessary to lower the gain in either the transmitting or receiving path at any one time to avoid regeneration.

The XR-T6420-2 and XR-T6421 chip set enables the system designer to make a highly adaptive, high performance speakerphone. The XR-T6421 provides for all sensing and control functions, while the XR-T6420-2 contains all audio paths needed to switch the gain in either path and provide interfacing between the system and line.

Speakerphone Control IC

GENERAL DESCRIPTION

The XR-T6421 is a monolithic integrated circuit for use in high performance speakerphone systems. It is designed to provide all control functions for the XR-T6420-1 or XR-T 6420-2 speakerphone audio circuit.

The XR-T6421 contains the level sensors and logic necessary to change the attenuation in the transmitting or receiving path in order to avoid acoustic feedback.

Circuitry is included to detect bacground noise level and provide a preset amount of attenuation in each path when no voice is present.

FEATURES

Low Current
Background Noise Detection and Suppression
External Control of Attach and Decay Time Constants
Independent Control of Gain and Frequency Response
Provides Three Level Control of Transmit & Receive Paths

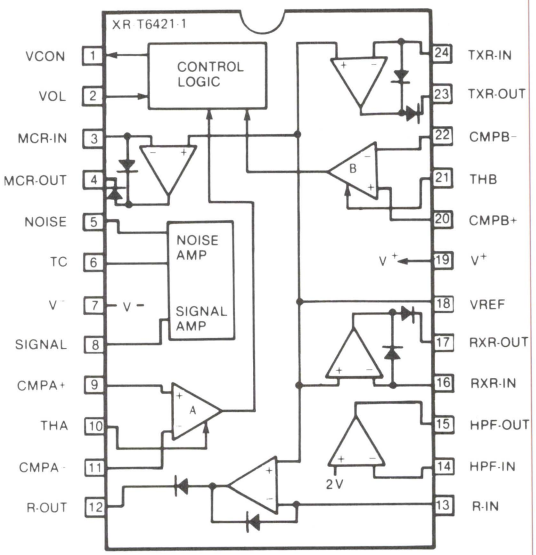
APPLICATIONS

Speakerphones
Intercoms
Voice Operated Switches

ABSOLUTE MAXIMUM RATINGS

Power Supply	20 V
Power Dissipation	1 W
Derate Above +25°C	7 mW/°C
Operating Temperature	0°C to 70°C
Any Input Voltage	V_{CC} +0.5 V to V_{EE} -0.5 V
Storage Temperature	-55 °C to 150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6421CN	Ceramic	0°C to 70°C
XR-T6421CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The speakerphone concept essentially requires that only one direction of sound transmission be permitted at any time. This restraint is brought about by the large gains required to provide loudspeaker volume and high microphone sensitivity. Owing to the inevitable acoustic coupling between loudspeaker and microphone, plus imperfections in the hybrid 2 to 4 wire conversion, it is necessary to lower the gain in either the transmitting or receiving path at any one time to avoid regeneration.

The XR-T6420-1 and XR-T6421 chip set enables the system designer to make a highly adaptive, high performance speakerphone. The XR-T6421 provides for all sensing and control functions, while the XR-T6420-1 contains all audio paths needed to switch the gain in either path and provide interfacing between the system and line.

Speakerphone IC

GENERAL DESCRIPTION

The XR-T6425 speakerphone IC is a low cost solution for the implementation of a hands-free telephone. It is a convenient way of carrying on conversation without using the handset, while the user is talking into a microphone and listening from a loudspeaker located on the desk. It is ideal for hands-free conference calls.

The XR-T6425 contains most of the circuits to eliminate singing and excessive background noise in a single chip solution.

FEATURES

Low Operating Voltage (4.5 V)
Single Chip Speakerphone
No External Adjustments
Smooth T/R Switching
Background Noise Detection and Suppression
On-chip Hybrid Circuit

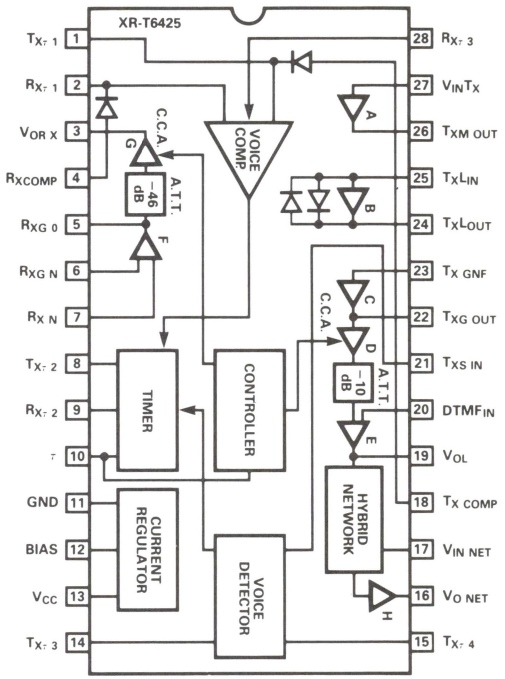
APPLICATIONS

Speakerphones
Intercoms
Voice Operated Switches

ABSOLUTE MAXIMUM RATINGS

Power Supply	16 V
Power Dissipation	700 mW
Operating Temperature	0°C to 70°C
Storage Temperature	-55°C to 150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6425CN	Ceramic	0°C to 70°C
XR-T6425CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-T6425 single chip speakerphone IC is designed to operate from the phone line and allows hands-free operation. The chip contains most of the necessary circuits to reduce external component count and performs half-duplex operation. The internal circuits consist of a transmitter, receiver and control logic. DTMF input is provided for Touch Tone operation. An adjustable threshold circuit is provided to separate voice from ambient noise.

Section 2—Telecommunication Circuits

Single Chip Pulse/Tone Dialer

GENERAL DESCRIPTION

The XR-T5990 Single Chip Pulse/Tone Dialer is a silicon gate CMOS technology circuit which performs both pulse and tone functions.

It is designed to operate directly from the telephone line or on a separate small power supply. A 17 digit buffer is provided for redial feature.

FEATURES

Pin Selectable Pulse/Tone Dialing
Low Standby Current
17 Digit Redial Buffer
Uses TV Crystal Standard 3.58 MHz or Ceramic Resonator to Provide High Accuracy and Stability
3.5 Second Pause Timer
Regulated Tone Amplitude
Pin Selectable Dialing Rate (10 pps/20 pps)
Pin Selectable Break Ratio (63%/66%)
Interface Directly to a Standard Telephone Push Button or Calculator Type X-Y Keyboard
Generates 12 Standard Tone Pairs
Single Tone and Dual Tone Capability

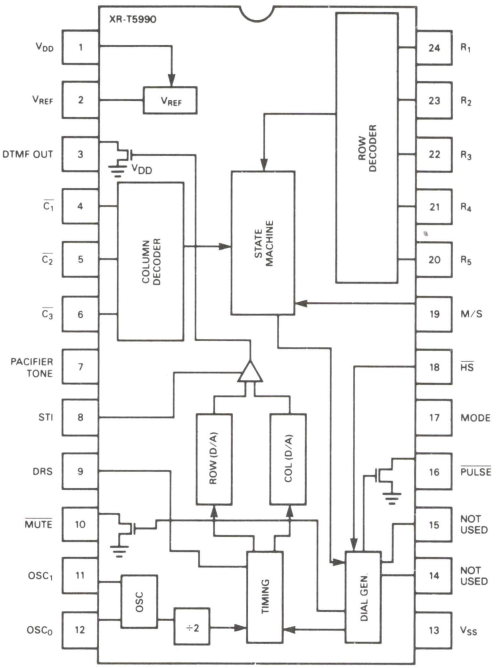
APPLICATIONS

Electronic Telephones
Smart Auto Dialers (modems)
Electronic Banking
Security Controller
Radio Communications

ABSOLUTE MAXIMUM RATINGS

DC Supply Voltage V_{DD}	6 V
Operating Temperature	0°C to 70°C
Input Voltage	$-.3 \leq V_{IN} \leq V_{DD} +.3$
Maximum Power Dissipation	500 mW

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5990CP	Plastic	0°C to 70°C
XR-T5990CN	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-T5990 Pulse/Tone Dialer is a CMOS integrated circuit that can provide recall of previously entered numbers as well as perform the normal dialing function. Dialing is interchangeable from pulse to tone or vice versa, capable of inserting 3.5 second pause between digits for PABX dialing.

The XR-T5990 dialer is capable of dialing * and # functions in tone mode and ignore in pulse mode. Selectable dialing rate is provided for rapid dialing.

Pulse Dialer

GENERAL DESCRIPTION

The XR-T5992 pulse dialer is a silicon gate CMOS integrated circuit which converts push-button inputs into pulses to simulate a rotary telephone dial.

It is designed to operate directly from the telephone line and to meet telephone specifications. A 17 digit buffer is provided for redialing feature. The XR-T5992 is available in a 18 pin package.

FEATURES

Direct Telephone Line Operation
Redial with Either a * or #-Input
Pin-Selectable Mark/Space and Dialing Rate
Inexpensive RC Oscillator
Interface Directly to a Standard Telephone
Push-button or Calculator Type X-Y Keyboard
Mute Driver on Chip
Pin-to-pin Compatible with MK50992

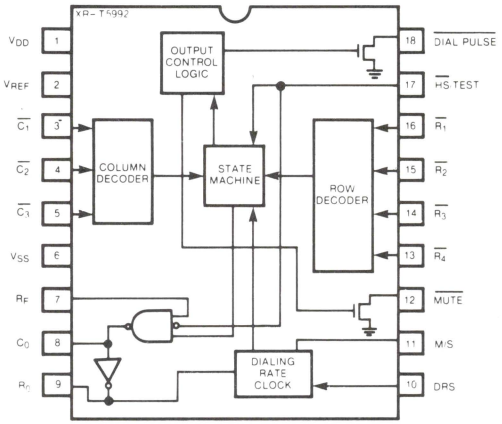
APPLICATIONS

Electronic Telephones
Smart Modems (Auto Dialer)
Security Controller

ABSOLUTE MAXIMUM RATINGS

DC Supply Voltage V^+	6.2 Volts
Operating Temperature	0°C to 70°C
Input Voltage	$-.3 \leq V_{IN} \leq V_{DD} +.3$
Maximum Power Dissipation	500 mW

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5992CP	Plastic	0°C to 70°C
XR-T5992CN	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-T5992 Pulse Dialer is a CMOS integrated circuit that can provide recall of previously entered numbers as well as perform the normal dialing function. It is capable of receiving keys faster than dialing rate. XR-T5992 is intended as a replacement for the mechanical telephone dial and can operate directly from the telephone line. Selectable dialing rate is provided for rapid dialing.

Speech Network

GENERAL DESCRIPTION

The XR-T5995 Speech Network is a monolithic integrated circuit specifically designed for implementing a low cost telephone set circuit. It is designed to use a electrodynamic microphone and electromagnetic receiver to replace a carbon microphone and telephone network hybrid.

FEATURES

Interfaces with Inexpensive Condenser Electret Microphone, Electromagnetic Receiver
Low Voltage CMOS Process to Operate from 20 mA to 100 mA Loop Current
Minimum External Component Counts
Uses Inexpensive and Non-critical External Components
A DTMF Input for Tone Dialing
External Mute Capability

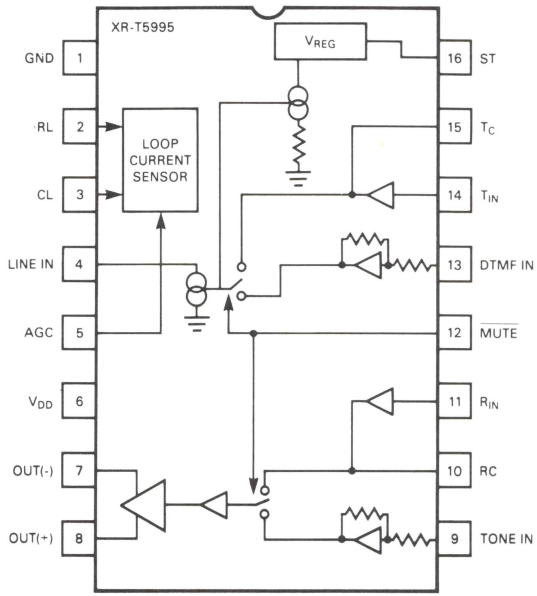
APPLICATIONS

Low Cost Telephone Set
Trimline Phone
Line Monitor

ABSOLUTE MAXIMUM RATINGS

DC Supply Voltage V_{DD}	15 V
Operating Temperature	0°C to 70°C
Power Dissipation	1100 mW
Storage Temperature	-55°C to 125°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T5995CP	Plastic	0°C to 70°C
XR-T5995CN	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-T5995 Speech Network contains all the necessary circuits to perform hybrid operation. (On board microphone, receiver amplifier and driver, external muting for tone dialing or pulse dialing.) A DTMF is provided to interface to Touch Tone dialing.

Tone Ringer

GENERAL DESCRIPTION

The XR-T8205 Tone Ringer is primarily intended as a replacement for the mechanical telephone bell. The device can be powered directly from telephone AC ringing voltage or from a separate DC supply. An adjustable trigger level is provided with an external resistor.

The XR-T8205 is designed for nominal 15 volt operation and is available in an 8 pin DIL package.

FEATURES

Low Supply Current
Operates Directly From Telephone Line
Provides Single or Dual Tone Frequencies to Simulate Mechanical Bell
Operates from 15 to 30 Volts
Pin-to-Pin Compatible with MITEL ML8205

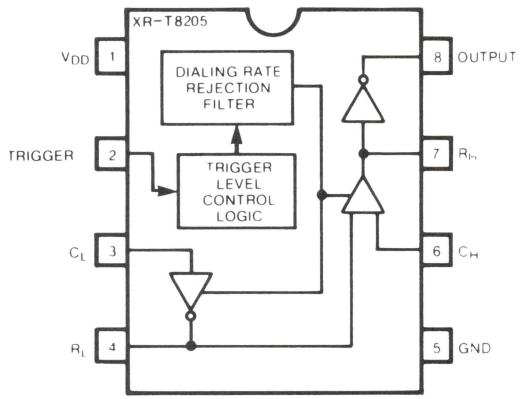
APPLICATIONS

Electronic Telephones
Alarm or Other Alerting Devices
Power Line Indicator
Toys

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-65°C to +150°C
Operating Temperature	0°C to 70°C
Supply Voltage	30 V
Input Voltage	$-.3\ V \leqslant V_{IN} \leqslant V_{DD} + .3\ V$

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T8205CP	Plastic	0°C to 70°C
XR-T8205P	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-T8205 Tone Ringer consists of two oscillator circuits, a dial reject filter and an amplifier to drive high impedance audio transformer or plezo-electric transducers.

The power supply control circuit provides the hysteresis required to ensure positive triggering of the device and to prevent transient triggering due to dial pulsing.

As the power supply voltage to the XR-T8205 is increased up to the supply initiation voltage (V_{SI}), oscillation begins. The low frequency oscillator oscillates at a rate of F_L controlled by an external resistor and capacitor, connected between Pins 3 and 4. The output of F_L is internally connected to the switching threshold cicuitry of the high frequency oscillator.

Section 2—Telecommunication Circuits

CMOS Dual Channel UART (DUART)

GENERAL DESCRIPTION

The EXAR Dual Univeral Asynchronous Receiver and Transmitter (DUART) is a data communications device that provides two fully independent full duplex asynchronous communications channels in a single package. The DUART is designed for use in micrprocessor based systems and may be used in a polled or interrupt driven environment.

Two basic versions of the DUART are available, each optimized for use with various microprocessor families: XR-88C681 for 8080/85, 8086/88, Z80, Z8000, 68xx and 65xx family based systems, and the XR-68C681 for 68000 family based systems. A programmable mode of the XR-88C681 version provides an interrupt daisy chain capability for use in Z80 and Z8000 based systems. However, the bus interfaces are general enough to allow interfacing with other microprocessors and microcontrollers. The XR--88C681 and XR-68C681 are enhanced versions of the Signetics, Motorola 2681 and 68681 respectively, and are pin and function compatible with those devices.

The DUART is fabricated using advanced two-layer metal high density CMOS process to provide high performance and low power consumption and is packaged in a 40 pin DIP. The XR-88C861 is also available in a 28 pin DIP.

FEATURES

Full Duplex, Dual Channel, Asynchronous
  Receiver and Transmitter
Quadruple-Buffered Receiver, Dual-Buffered Transmitter
Stop Bits Programmable in 1/16-bit Increments
Internal Bit Rate Generator with 23 Bit Rates
Independent Bit Rate Selection for Each
  Receiver and Transmitter
Maximum Bit Rate: 1x Clock - 1 Mb/Sec,
  16x Clock - 125Kb/Sec
Normal, Autoecho, Local Loopback, and
  Remote Loopback Modes
Multi-Function 16-Bit Counter/Timer
Interrupt Output with Eight Maskable Interrupting Cond.
Interrupt Vector Output on Acknowledge
Programmable Interrupt Daisy Chain
Up to 15 I/O Pins (Depending on Package and Version)
Change of State Detectors on Inputs
Multidrop Mode Compatible with 8051 Nine-Bit Mode
On-Chip Oscillator for Crystal
Standby Mode to Reduce Operating Power
Advanced CMOS Low Power Technology

ABSOLUTE MAXIMUM RATINGS

Operating Temperature	0°C to +70°C
Storage Temperature	−65°C to +150°C
All Voltages with Respect to Ground	−0.5 V to +7.0 V

ORDERING INFORMATION

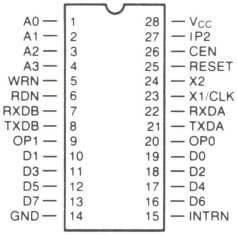
XR-88C681/40XX, XR-88C681/28XX, and XR-68C681/XX are offered in the following packages.

XX=Suffix	Package	Operating Temperature
CN	Ceramic	0°C to +70°C
N	Ceramic	−40°C to +85°C
M	Ceramic	−55°C to +125°C
L	Ceramic LCC	−40°C to +85°C
ML	Ceramic LCC	−55°C to +125°C
CP	Plastic	0°C to 70°C
P	Plastic	−40°C to 85°C
CJ	PLCC	0°C to 70°C
J	PLCC	−40°C to 85°C

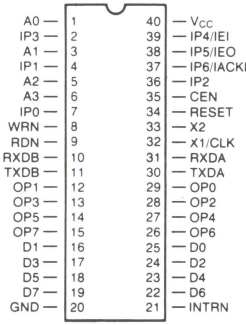
Contact factory for additional information.

FUNCTIONAL BLOCK DIAGRAMS

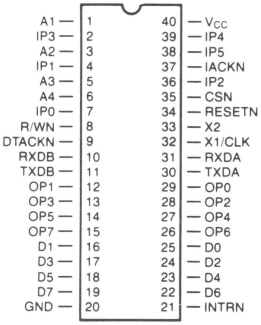
XR-88C681/28



XR-88C681/40



XR-68C681



EXAR

Section 3—Data Communication Circuits

Bell 212A Type Modulator

GENERAL DESCRIPTION

The XR-2121 is designed to provide the complete modulator function for a Bell 212A type modem. The circuit accepts a synchronous serial data stream and generates either a 300 BPS frequency shift keyed (FSK) or a 1200 BPS differential phase shift keyed (DPSK) carrier signal. An on-board digital-to-analog converter provides a synthesized sine wave output. Also provided on the transmitted carrier output is an inverting amplifier with external feedback resistor to provide a carrier amplitude adjust.

The XR-2121 contains an internal 17 bit scrambler. This scrambler which is used during DPSK operation has a disable input for sending non-scrambled carriers.

A 1200 Hz transmit clock output is provided for 1200 BPS operation, although the XR-2121 will also accept an external transmit clock. For test or other purposes, a 600 Hz baud clock output is also supplied.

The XR-2121 is constructed using silicon gate CMOS technology. The main clock frequency input is 1.8432 MHz. The XR-2121, available in a 22 Pin (0.4 inch wide) package, is designed to operate from +5 volt and -5 volt power supplies.

FEATURES

Bell 212A Compatible
1200 BPS DPSK
300 BPS FSK
Digital Modulation Techniques for DPSK
External Transmit Clock Input
600 Hz Dibit Clock Output
Complete Scrambler Function with Disable Input
Transmit Carrier Level Adjust
1.8432 MHz Clock
±5 Volt Operation

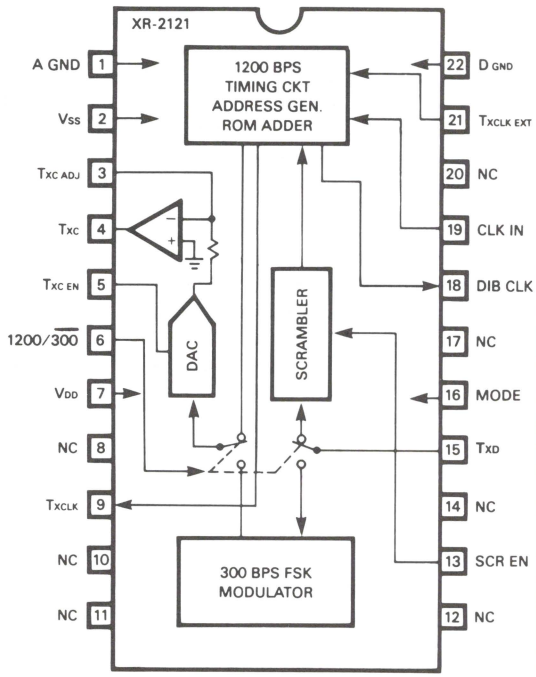
APPLICATIONS

Bell 212A Type Modulator
Bell 103 Type Modulator

ABSOLUTE MAXIMUM RATINGS

Power Supply	
V_{DD}	-0.3 to +7V
V_{SS}	+0.3 to -7V
Input Voltage	V_{SS} -0.3V to V_{DD} +0.3V
DC Input Current	±10 mA
Power Dissipation	1.0 W
Derate Above 25°C	5 mW/°C
Storage Temperature Range	-65°C to +125°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2121CN	Ceramic	0°C to 70°C
XR-2121CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-2121 basically has two types of operation, 1200 BPS DPSK or 300 BPS FSK. For 1200 DPSK the XR-2121 generates carrier frequencies of 1200 Hz or 2400 Hz, depending on mode selection (originate or answer). The carrier frequencies are imposed with phase shifts to carry the data to be transmitted (T_{XD}) over the telephone network. The phase shifts correspond to the incoming data grouped in pairs (dibits) and are one of four values — 0°, 90°, −90°, 180°.

During 300 BPS FSK operation, the XR-2121 generates one of two pairs of frequencies to represent the T_{XD}. These pairs are either 1070 Hz/1270 Hz or 2025 Hz/2225 Hz depending on mode selection.

Bell 212A Type Demodulator

GENERAL DESCRIPTION

The XR-2122 is designed to perform the complete Bell 212A type modem demodulator function. Both 1200 BPS differential phase shift keyed (DPSK) and 300 BPS frequency shift keyed carrier demodulation is performed by the XR-2122. The 1200 BPS portion utilizes coherent demodulation, while the 300 BPS uses phase-locked loop techniques. For 1200 BPS operation, an internal 17 bit descrambler provides the descrambled output with the non-descrambled output also available.

Automatic speed selection is performed by a handshake circuit. Carrier detect outputs are supplied for FSK data, PSK data, and conventional energy detection.

A non-committed operational amplifier is supplied to provide receive carrier sensitivity tailoring. An automatic gain control circuit (AGC) assures wide dynamic input carrier range.

The XR-2122 is constructed using silicon gate CMOS technology. The XR-2122 is designed to operate off of a 1.8432 MHz clock input. Available in a 28 Pin package, the XR-2122 is designed for +5 volt and -5 volt power supplies.

FEATURES

Bell 212A Compatible
1200 BPS DPSK Coherent Demodulation
300 BPS FSK Demodulation
Eye Diagram Output
Internal 17 Bit Descrambler
Non-descrambled Demodulation Output Available
FSK, PSK and Energy-type Carrier Detect Outputs
Automatic Speed Selection
Non-committed Op Amp for Input AGC Amplifier
AGC Input Circuit for Wide Dynamic Range

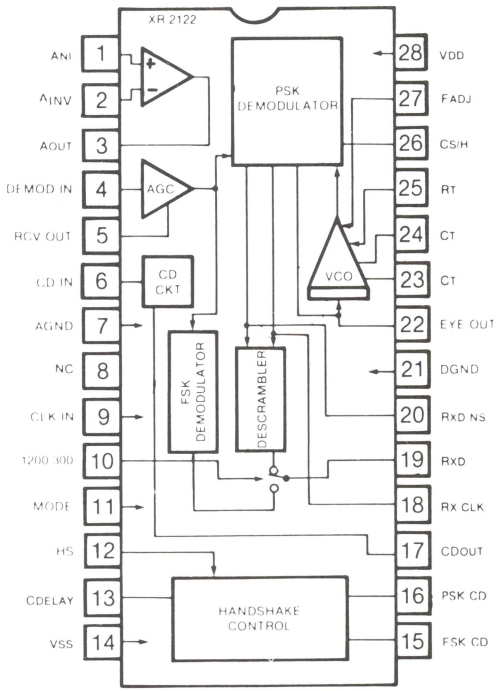
APPLICATIONS

Bell 212A Type Demodulator
Bell 103 Type Demodulator

ABSOLUTE MAXIMUM RATINGS

Power Supply	
V_{DD}	-0.3 to 7 V
V_{SS}	0.3 to -7 V
Input Voltage	V_{SS} -0.3V to V_{DD} +0.3V
DC Input Voltage	±10 mA
Power Dissipation	750 mW
Derate Above 25°C	5 mW/°C
Storage Temperature Range	-65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2122CN	Ceramic	0°C to 70°C
XR-2122CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-2122 provides two basic types of operation; demodulation for either 1200 BPS DPSK or 300 BPS FSK encoded incoming carriers. For either speed, the incoming carrier is passed through a gain stage (uncommitted op amp) and an AGC circuit to condition the signal. For 1200 BPS, the signal is processed using coherent demodulation techniques (Costas Loop)

For 300 BPS, a digital phase-locked loop type of demodulator is used providing low bias and jitter distortion without adjustments.

PSK Modulator/Demodulator

GENERAL DESCRIPTION

Each of these devices provide the modulator and demodulator for phase-shifted keyed modulated signals. The devices have an on-chip digital-to-analog converter, allowing digital external programming of Bell 212A, CCITT V.22 or V.26 functions.

The XR-2123 provides the modulator and demodulator functions. It is adequate for Bell 212A (1200 BPS only) and Bell 201 standards. The XR-2123 requires a synchronous-to-asynchronous converter and scrambler-descrambler for the digital portion of the modem for 212A applications. Level shifters and filtering is required for the analog portion.

The XR-2123A provides the ±7 Hz carrier capture range needed for V.22 and V.26. It is externally identical to the XR-2123.

The XR-2123 and XR-2123A utilize CMOS technology for power operation while providing single 5 volt operation. Both devices come in a 28 pin DIL pin package in either plastic or ceramic.

FEATURES

Single +5 Volt Operation
Low Power Consumption (typ. 10 mw)
1200 BPS Full Duplex
2400 BPS Half Duplex
Programmable for US or European Standards (CCITT)
Dibit PSK (DPSK) Operation
Cyrstal Controlled
Synthesized Sine Wave Modulator Output
Adjustable Modulator Output Amplitude
Input Protection

APPLICATIONS

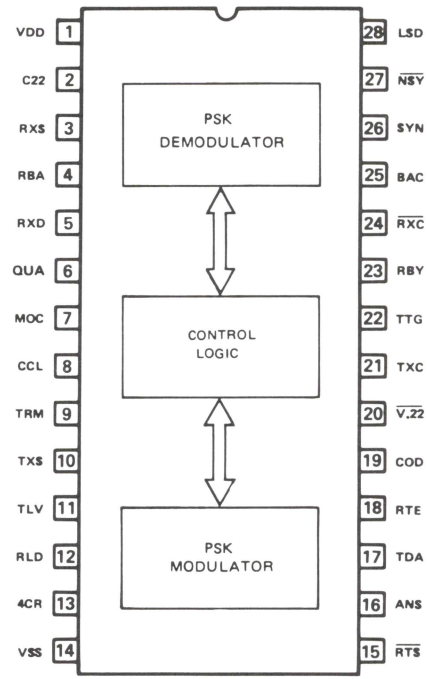
Bell Standard 201 or 212A Modems
CCITT Standard V.22 or V.26 Modems

ABSOLUTE MAXIMUM RATINGS

Power Supply	5.5 V
Power Dissipation	1.0 W
Derate Above 25°C	5 mW/°C
Operating Temperature	0°C to 70°C
Storage Temperature	-65°C to 150°C
All Input Voltage	-0.5 V to (V_{DD} + 0.5 V)
DC Current Into Any Input*	±1 mA

*Please note that with polysilicon gate inputs, the maximum voltage rating at any pin may be reached before the absolute maximum current of the input is reached. Caution should be used.

FUNCTIONAL BLOCK DIAGRAMS



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2123CN	Ceramic	0°C to +70°C
XR-2123CP	Plastic	0°C to +70°C
XR-2123ACN	Ceramic	0°C to +70°C
XR-2123ACP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2123 and XR-2123A provide the complete modulation and demodulation of DPSK modem systems. The modulator transmits a sampled sine wave in dibit phase-shifted keyed format (DPSK). The phase shifts and carrier frequencies are controlled with logic inputs. With these controls, a Bell 212A/CCITT V.22 or a Bell 201/CCITT V.26 can be created.

The XR-2123 and XR-2123A require a separate scrambler/descrambler and synchronous-to-asynchronous converter.

Data Buffer

GENERAL DESCRIPTION

The XR-2125 is a logic circuit designed to perform the data buffer function for Bell 212A Type Modem Systems. Both asynchronous to synchronous and synchronous to asynchronous conversion are performed at nominal data rates of 1200 bits per second. The XR-2125 is selectable for character lengths of 9 or 10 bits. Separate enable/disable inputs are supplied for async to sync and sync to async converter sections. These inputs allow the same data lines to be used for asynchronous or synchronous operation.

The receive data buffer section (sync to async) accepts input sync data (typically from the modem demodulator) at 1200 BPS and converts it to a 1219 BPS async data format. The transmit data buffer (async to sync) accepts input async format data with a data rate of 1200 BPS +1%, -2.5% and it is synchronized to 1200 BPS, which is typically sent to the modulator. This section also provides break signal automatic extension.

The XR-2125 is constructed using silicon gate CMOS technology for low power operation. Operation is designed for an input clock frequency of 1.8432 mHz. The XR-2125, available in a 14 Pin package, is designed for single 5 volt operation.

FEATURES

Bell 212A Compatible
Asynchronous to Synchronous Conversion
Synchronous to Asynchronous Conversion
Independent Disable Input for
  Receiver and Transmitter Sections
1.8432 MHz Clock
Break Signal Automatic Extension for Transmitter
1200 BPS +1%, -2.5% Operation
Single 5 Volt Operation

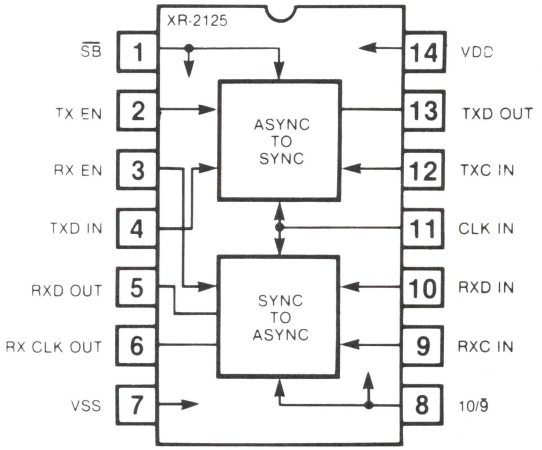
APPLICATIONS

Bell 212A Data Buffer

ABSOLUTE MAXIMUM RATINGS

Power Supply	-0.3 to +7.0 V
Input Voltage	-0.3 to V_{DD} +0.3
DC Input Current (any input)	±10 mA
Power Dissipation	250 mW
Storage Temperature Range	-65°C to +125°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2125CN	Ceramic	0°C to 70°C
XR-2125CP	Plastic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-2125 provides the complete interface between synchronous and character - asynchronous data systems. The synchronous side consists of two data lines, T_{XD} and R_{XD}, each with their respective clocks, T_{XC} and R_{XC}. The synchronous portion is designed for data rates of 1200 ± .01% BPS. The asynchronous side handles data oriented in characters where the actual data bits are bracketed by a start and stop bit. Character lengths are 9 or 10 bit (7 or 8 data bits), pin selectable.

To perform this interface, the XR-2125 consists of two main sections: synchronous to asynchronous (receive section) converter to reinsert stop bits deleted by the sending modem. The other section is the a synchronous to synchronous converter (transmit section) to add or delete stop bits to correct the transmit data rate to 1200 BPS. This section also extends the break signal to two character lengths plus three bits when it comes in at a shorter period.

A standby mode is included to put the XR-2125 in a low supply current, non-operative, mode on command.

FSK Modem System

GENERAL DESCRIPTION

The XR-14412 contains all the necessary circuitry to construct a complete FSK modulator/demodulator (MODEM) system. Included is circuitry for pin-programmable frequency bands, either U.S. or foreign (CCITT) standards for low-speed MODEMS. The XR-14412 provides T^2L-compatible inputs and outputs. Included in the XR-14412 are features for self-testing and an echo suppression tone generator. The XR-14412 utilizes complementary MOS technology for low-power operation.

FEATURES

Simplex, Half-Duplex, and Full-Duplex Operation
Crystal Controlled
Answer or Originate Modes
Single Supply Operation
Self-test Mode
Selectable Data Rates—300, or 600 bps
T^2L- or CMOS-Compatible Inputs and Outputs
Echo Suppressor Disable Tone Generator
U.S. or Foreign (CCITT) Compatible

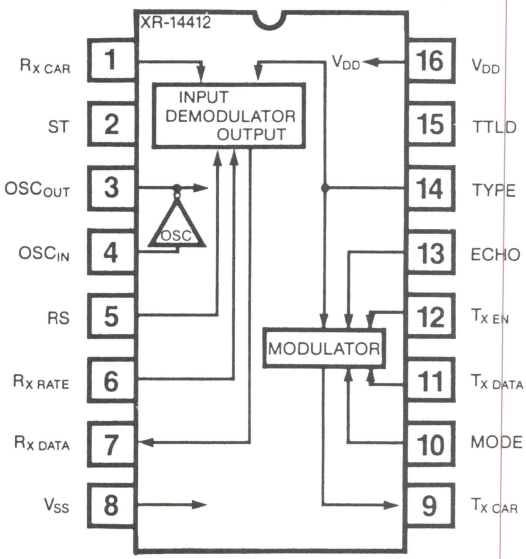
APPLICATIONS

Stand-Alone MODEMS
Remote Terminals
Acoustical Couplers
Built-in MODEMS

ABSOLUTE MAXIMUM RATINGS

Power Supply	
XR-14412F	15V
XR-14412V	6V
Any Input Voltage	V_{DD} + .5V to V_{SS} − .5V
Output Current from any Pin (Except Pins 7 or 8)	10 mA
Output Current from Pin 7 or 8	35 mA
Operating Temperature Range	−40°C to +85°C
Storage Temperature Range	−65°C to +150°C
Power Dissipation	
Ceramic Package	1000 mW
Derate Above T_A = +25°C	8.0 mW/°C
Plastic Package	625 mW
Derate Above T_A = +25°C	5.0 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Voltage Range
XR-14412FP	Plastic	4.75V to 15V
XR-14412VP	Plastic	4.75V to 6V
XR-14412FN	Ceramic	4.75V to 15V
XR-14412VN	Ceramic	4.75V to 6V

SYSTEM DESCRIPTION

The XR-14412 is basically comprised of two main components; the FSK modulator and demodulator. The modulator serves to convert or encode incoming binary data into two discrete frequencies. The pair of frequencies generated are determined by which standard (US or CCITT), and mode (answer or originate), are selected. These frequencies are within a range suitable for transmission over the telephone lines. The demodulator performs the opposite function by decoding the received pairs of frequencies into binary data. It also responds to those frequencies selected by the standard and mode selected. All functions within the XR-14412 are digital and controlled by a master clock. This clock is generated by an external crystal connected between the OSC_{IN} and OSC_{OUT} pins. As well as being used internally by the 14412, the clock may be used to clock other circuitry by using the OSC_{OUT} pin.

Section 3—Data Communication Circuits

General Purpose Low Pass Filter

GENERAL DESCRIPTION

The XR-1000 is a general purpose 4th order low pass filter utilizing switched capacitor (SCF) circuit techniques. XR-1000 is available in several options providing Butterworth or Chebyshev filter responses. The Chebyshev option is also available with passband ripple specifications of 0.1 or 0.5 dB specifications.

The SCF techniques used provide a clock tunable cutoff frequency, with either 50:1 or 100:1 clock to cutoff frequency ratios available. The clock may be externally generated or an on-board Schmitt trigger is supplied for providing an internal clock with an external resistor/capacitor combination.

The XR-1000, utilizing CMOS technology, is available in a 14-Pin package. The XR-1001 → 1008 is available in an 8-Pin package.

FEATURES

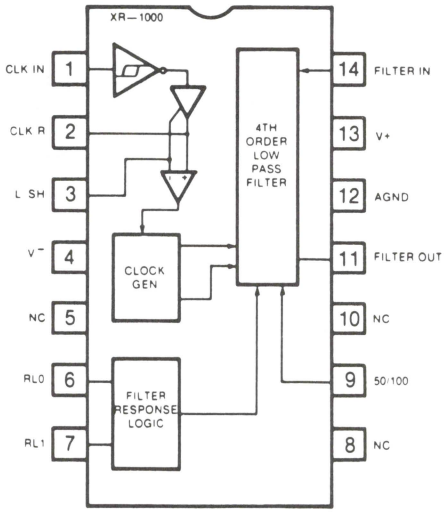
Switched Capacitor Circuit Techniques
Single 5 Volt Operation
Low External Parts Count
No Precision Components Necessary
Low Power Operation
50:1/100:1 Clock to Cutoff Frequency Options

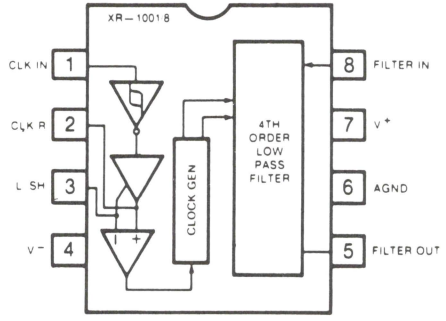
0.1 to 20 kHZ Cutoff Frequency Range
Internal/External Clock Operation

APPLICATIONS

General Purpose Low Pass Filters
Telecom Filtering
Medical Systems
Audio Applications
Data Acquisition Systems

FUNCTIONAL BLOCK DIAGRAMS





ORDERING INFORMATION

Part Number	Package	Pins	Response/Ripple	f_{CLK}/f_C	Operating Temperature Range
XR-1000CP/CN	Plastic/Ceramic	14	BW-CH/–	50/100	0°C to 70°C
XR-1001CP/CN	Plastic/Ceramic	8	BW/–	100	0°C to 70°C
XR-1002CP/CN	Plastic/Ceramic	8	BW/–	50	0°C to 70°C
XR-1003CP/CN	Plastic/Ceramic	8	CH/0.01 dB	100	0°C to 70°C
XR-1004CP/CN	Plastic/Ceramic	8	CH/0.01 dB	50	0°C to 70°C
XR-1005CP/CN	Plastic/Ceramic	8	CH/0.1 dB	100	0°C to 70°C
XR-1006CP/CN	Plastic/Ceramic	8	CH/0.1 dB	50	0°C to 70°C
XR-1007CP/CN	Plastic/Ceramic	8	CH/1.0 dB	100	0°C to 70°C
XR-1008CP/CN	Plastic/Ceramic	8	CH/1.0 dB	50	0°C to 70°C

Seventh Order Elliptic Low Pass Filters

GENERAL DESCRIPTION

The XR-1015 and XR-1016 are seven pole and six zero elliptic low pass switched capacitor filters. The position of the passband of the filter is set by the frequency of the clock which allows for easy adjustment. The use of switched capacitor filters reduces the amount of variation in the filter response that occurs with discrete use of capacitors, inductors and resistors. The XR-1015 and XR-1016 also provide synchronized sampled inputs and outputs that allows the device to be cascaded without the need of an additional sample and-hold. The XR-1015 and XR-1016 are produced with a 3 um polysilicon gate dual metal CMOS process for low power consumption.

The XR-1015 is an eight pin device that can operate from ±2.5 VDC to ±5 VDC. The device can also be biased so that it can be operated with a single +5 to +10 VDC supply. It is pin-for-pin compatible with the Reticon R5609 with the added advantage of operating to +5VDC single supply. The clock to corner ratio of the XR-1015 is fixed at 100:1.

The XR-1016 is a 14 pin device which provides two uncommitted operational amplifiers for use as a reconstruction filter, anti-aliasing filters or for additional pre-filter gain. The XR-1016, as does the XR-1015, provides a clock output with the voltage output from rail to rail. The XR-1016 has the ability to change the clock to corner ratio from 100:1 to 50:1. The output clock can be used to strobe an analog to digital converter or to synchronize any additional circuits in the system.

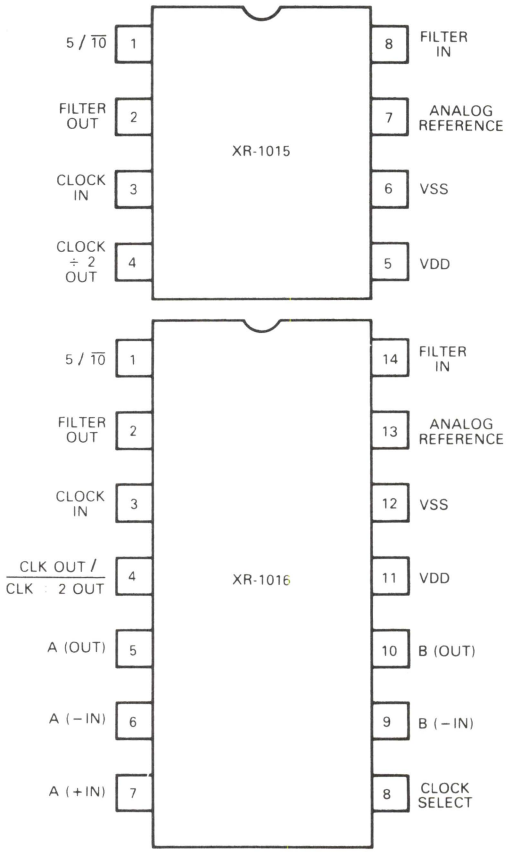
FEATURES

Greater than 70 dB Stopband Rejection
Operation at +5 VDC (at 20 kHz f_{CLOCK})
Precise Filter Positioning
Low Power Consumption
No External Components Required for Filter

APPLICATIONS

General Purpose Filtering
Anti-alias Filters (for analog-to-digital converters)
Reconstruction Filters (for digital-to-analog converters)
Band Limiting of Voice for Linear Predictive Coding
Digital Signal Processing Front End
Filtering of Voice for Music for Special Effects
(echo, phasing, etc.)

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply	14 V
Input Signal Level	$V^+ - 0.7$ to $V^- + 0.7$ V
Power Dissipation - XR-1016	
Ceramic Package	700 mW
Derate Above T_A = +25°C	6 mW/°C
Plastic Package	625 mW
Derate Above T_A = +25°C	5 mW/°C
Power Dissipation - XR-1015	
Ceramic Package	385 mW
Derate Above T_A = +25°C	2.5 mW/°C
Plastic Package	300 mW
Derate Above T_A - +25°C	2.5 mW/°C
Storage Temperature	−55°C to +150°C

FSK Modem Filter

GENERAL DESCRIPTION

The XR-2103 is a Monolithic Switched-Capacitor Filter designed to perform the complete filtering function necessary for a Bell 103 Compatible Modem. The XR-2103 is specifically intended for use with the XR-14412 Modulator/Demodulator to form a complete stand alone two-chip modem. In addition to complete high and low bandpass filters, the XR-2103 contains internal mode switching, auto-zeroing limiter and dedicated duplexer op amp. An on board carrier detect circuit is also included to complete the overall system. Designed for crystal-controlled operation, the XR-2103 operates from a 1.0 MHz crystal or external clock. Buffered clock output is provided for the XR-14412. A self-test circuit is included.

The XR-2103, available in a 20 pin package, utilizes CMOS technology for low power operation with a supply voltage range from 4.75V to 6V.

FEATURES

Single 5 Volt Operation
Complete On Board Output Active Filters
Low Supply Current
Internal Answer/Originate Mode Switching
Programmable Input Receive Gain
Carrier Detect Output
Active Duplexer

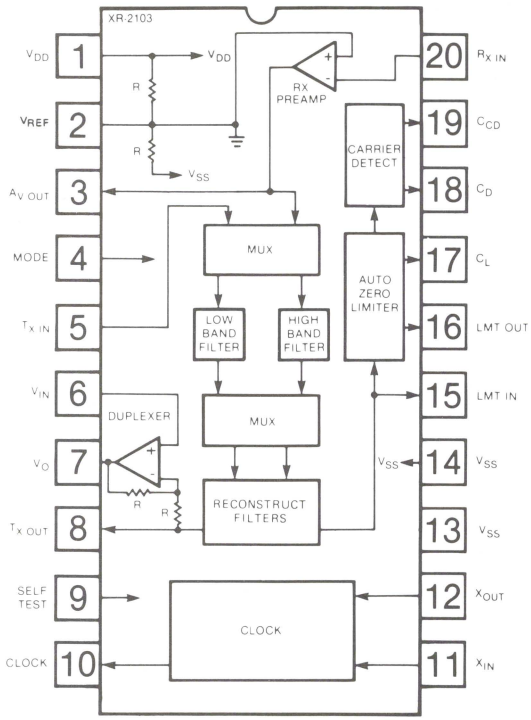
APPLICATIONS

Bell 103 Transmit/Receive Filtering
Complement to XR-14412 or Other
Modulators/Demodulators

ABSOLUTE MAXIMUM RATINGS

Power Supply	16V
Power Dissipation Plastic Package	650 mW
Derate Above 25°C	5.0 mW/°C
Power Dissipation Ceramic Package	1.0 W
Derate Above 25°C	8.0 mW/°C
Operating Temperature	0°C to 70°C
Storage Temperature	-65°C to 150°C
Any Input Voltage	(V_{DD} + 0.5V) to (V_{SS} -0.5V)

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2103CP	Plastic	0°C to 70°C
XR-2103CN	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-2103 internally consists of four main signal blocks. They are: input and output multiplexers to route the transmit and receive signals to the proper filter and output, according to the mode input; high and low band filters, 6 poles each, to perform precise bandpass filtering; output RC active filters to perform output reconstruction and filtering; carrier detection circuit for system interfacing.

An input amplifier with programmable gain is provided for the receive signals. The XR-2103 contains an internal clock oscillator which accepts either a crystal or an external oscillator of 1 MHz.

PSK Modem Filter

GENERAL DESCRIPTION

The XR-2120 is a self-contained bandpass filter set designed for realization of Bell 212A compatible 1200 bits/sec PSK modems. The XR-2120 utilizes CMOS technology and switched capacitor circuit techniques to minimize external components to a single crystal or frequency source. Contained in the device are two complete bandpass filters centered around the Bell standard 1200 Hz and 2400 Hz send and receive frequencies. These filters also provide compromise line equalization. Additional features included are digitally programmable transmit and receive gains as well as input anti-aliasing and complete output smoothing filters. Separate V_{SS} pins for transmit, receive, and digital sections are provided to minimize crosstalk.

The XR-2120 features guaranteed filter group delay specifications, within ±100μS of nominal. The XR-2120C is a relaxed version of the XR-2120 with group delay specified within ±150μS. The devices are available in a 22 pin (0.4 inch wide) plastic or ceramic package, and operate over a wide range of supply voltages.

FEATURES

On-board Crystal Oscillator With Buffered Output
Internal Anti-aliasing Filters
Complete On-board Output Active Filters
Digitally Programmable Transmit and Receive Gains
MODE Input Internally Switches Filters
for Answer/Originate
Single or Split Supply Operation
Center Frequencies Movable with Input Clock
High-Impedance Inputs (100 kΩ min)
1% Center Frequency Accuracy
Separate CLK IN and CLK OUT Pins

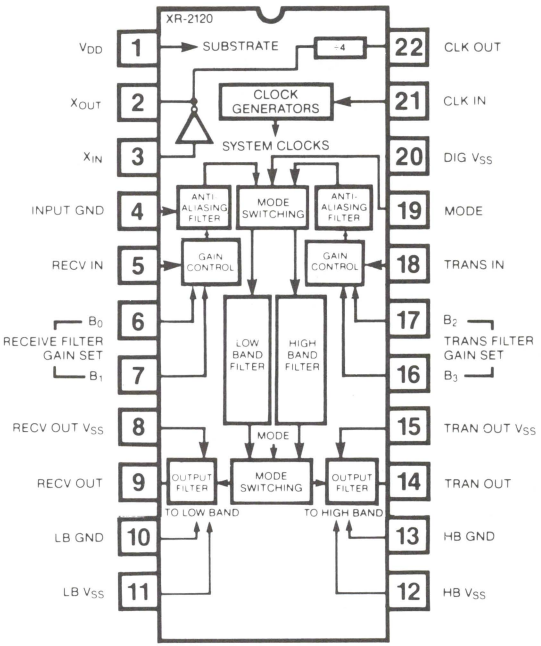
APPLICATIONS

Bell 212A Transmit/Receive Filtering
Answer Back Signal Filtering

ABSOLUTE MAXIMUM RATINGS

Power Supply	16V
Power Dissipation, Plastic	1.0W
Derate Above 25°C	5 mW/°C
Power Dissipation, Ceramic	1.3W
Derate Above 25°C	7 mW/°C
Operating Temperature	0°C to 70°C
Storage Temperature	-65°C to 150°C
Any Input Voltage	(V_{DD} + 0.5V) to (V_{SS} - 0.5V)

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2120CN	Ceramic	0°C to +70°C
XR-2120CP	Plastic	0°C to +70°C
XR-2120N	Ceramic	0°C to +70°C
XR-2120P	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2120 is comprised of four main signal blocks: The digitally programmable gain amplifier, an input anti-aliasing switched capacitor filter, switched capacitor bandpass filters at 1200 Hz and 2400 Hz, and output RC active filters. These sections serve to: (1) amplify and condition incoming signals, (2) remove noise which can cause aliasing problems in the bandpass filters, (3) provide very precise bandpass filtering and phase compensation, and (4) perform output reconstruction and filtering. To perform these necessary filtering and phase compensation functions, a total of 48 poles are used in the XR-2120.

The programmable gain stages provide 4 selectable gains for transmit or receive. Separate clock output and input pins are provided for flexibility.

Bell 212A/CCITT V.22 Modem Filters

GENERAL DESCRIPTION

The XR-2126/2127/2128/2129 modem filters are monolithic CMOS switched capacitor filters designed for use in full duplex 1200 BPS modems. They meet all the filtering functions of the Bell 212A and CCITT V.22 modem specifications. They include the low band (centered at 1200 Hz) and high band (centered at 2400 Hz) filters with full channel compromise equalization and output smoothing filters for both bands.

For CCITT V.22 applications, a notch filter is included that can be selected for either 550 Hz or 1800 Hz and provide greater than 55 dB of rejection at these frequencies. Also included in these devices are two uncommitted operational amplifiers which can be used for input anti-aliasing filtering or for additional gain, and additional equalization for Worst Case Line (3002, C_O) conditions.

The XR-2126 is pin and function compatible to the AMI S35212 while the XR-2127 is pin and function compatible to the AMI S35212A. The XR-2128 is an enchanced version of the XR-2126 and XR-2127. Like the S35212 and S35212A, the high band filter in the XR-2126, XR-2127 and XR-2128 can be scaled down by a factor of 6 so it can be used to monitor Call Progress tones in smart modems. And, like the S35212A, the XR-2127 and XR-2128 have analog loop back mode for testing the functions of the modem.

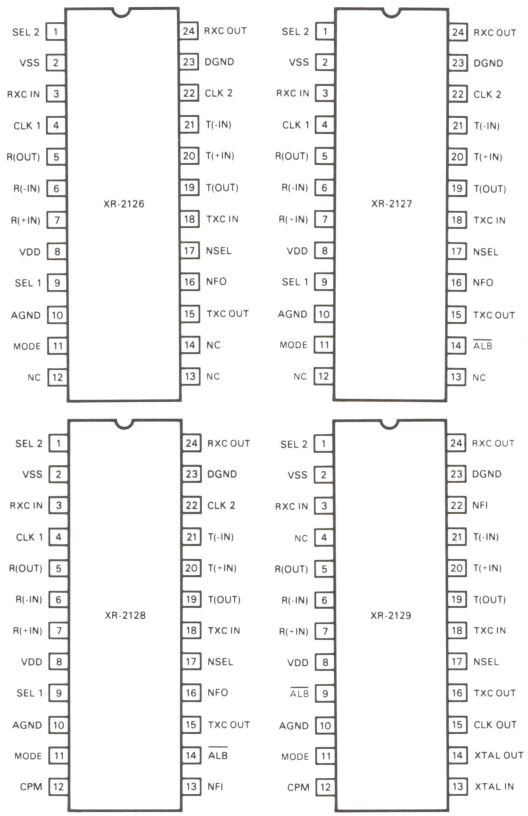
The XR-2128 contains two additional control pins, CPM (Pin 12) and NFI (Pin 13), that allow more accurate Call Progress Monitoring and easier V.22 implementation without the need for external multiplexers and smoothing filters. The CPM pin scales the low band filter by a factor of 2.5 for better centering over the Call Progress frequency range of 300 to 660 Hz, allowing the unscaled high band filter to be used for monitoring the modem answer tone.

The XR-2129 is an EXAR version of the 212A/V.22 modem filter. All the features of the XR-2126/2127/2128 except the clock frequencies are provided. The XR-2129 operates from a 1.8432 MHz crystal with an onboard clock oscillator. It also features a 1.8432 MHz buffered clock output and 10 dB of gain in the receive path. When used with the XR-2121 modulator, XR-2122 demodulator, and XR-2125 buffer, and a small amount of external circuitry, all the functions needed to realize the Bell 212A modem are in place.

APPLICATIONS

Bell 212A Modem Filtering
CCITT V.22 / V.22bis Modem Filtering
Bell 103 Modem Filtering
Other Modem Filter Applications

FUNCTIONAL BLOCK DIAGRAMS



FEATURES

Bell 212A/CCITT V.22 Compatible Transmit and Receive Filters with Full Channel Compromise Equalization
Selectable V.22 Notch Filters Included (550 Hz/1800 Hz)
Built-in Call Progress Mode/Enhanced Call Progress Mode
Analog Loop Back Capability
Phone Line Status Monitor Capability (Bypass Mode)
Additional Equilization for Worst Case Line (3002, C_O) Conditions (XR-2128/XR-2129 only)
On-chip Transmit and Receive Output Smoothing Filters
Two Uncommitted Operational Amplifiers
Choice of Clock Frequencies:
153.6 KHz or 1.2288 MHz/2.4576 MHz on XR-2126, XR-2127, XR-2128
1.8432 MHz Crystal with On-Chip Clock Oscillator on XR-2129
TTL/CMOS Compatible Digital Inputs

Section 3—Data Communication Circuits

Quad Line Driver/Receiver

GENERAL DESCRIPTION

The XR-1488 is a monolithic quad line driver designed to interface data terminal equipment with data communications equipment in conformance with the specifications of EIA Standard No. RS232C. This extremely versatile integrated circuit can be used to perform a wide range of applications. Features such as output current limiting, independent positive and negative power supply driving elements, and compatibility with all DTL and TTL logic families greatly enhance the versatility of the circuit.

The XR-1489A is a monolithic quad line receiver designed to interface data terminal equipment with data communications equipment. the XR-1489A quad receiver along with its companion circuit, the XR-1488 quad driver, provide a complete interface system between DTL or TTL logic levels and the RS232C defined voltage and impedance levels.

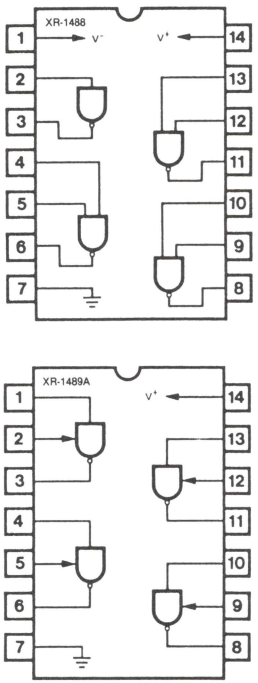
ABSOLUTE MAXIMUM RATINGS

Power Supply	
XR-1488	±15 Vdc
XR-1489A	+10 Vdc
Power Dissipation	
Ceramic Package	1000 mW
Derate above +25°C	6.7 mW/°C
Plastic Package	650 mW/°C
Derate above +25°C	5 mW/°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1488N	Ceramic	0°C to +70°C
XR-1488P	Plastic	0°C to +70°C
XR-1489AN	Ceramic	0°C to +70°C
XR-1489AP	Plastic	0°C to +70°C

FUNCTIONAL BLOCK DIAGRAMS



SYSTEM DESCRIPTION

The XR-1488 and XR-1489A are a matched set of quad line drivers and line receivers designed for interfacing between TTL/DTL and RS232C data communication lines.

The XR-1488 contains four independent split supply line drivers, each with a ±10 mA current limited output. For RS232C applications, the slew rate can be reduced to the 30 V/μS limit by shunting the output to ground with a 410 pF capacitor. The XR-1489A contains four independent line receivers, designed for interfacing RS232C to TTL/DTL. Each receiver features independently programmable switching thresholds with hysteresis, and input protection to ±30 V. The output can typically source 3 mA and sink 20 mA.

EXAR

Section 4—Computer Peripheral Circuits

Hard Disk Read/Write

GENERAL DESCRIPTION

The XR-117 is a high speed head interface integrated circuit for hard disk drives, performing both read and write functions. The XR-117 is compatible with 3½" to 14" single and multiple platter drives, and features high bandwidth, large dynamic range, and low noise. Several packaging options extend usefulness to applications requiring two, four, or six center-tapped read/write heads; multiple devices are easily cascaded for drives with more heads.

The XR-117, manufactured with a high speed bipolar process, operates on +5 V and +12 V.

FEATURES

Complete Head Interfacing Functions, Read and Write
High Bandwidth and Dynamic Range
Low Noise
Available in Two, Four, and Six Head Versions
Easily Cascaded for Larger Systems
Power Monitor with Automatic Disable
TTL Compatible Inputs

APPLICATIONS

Single or Multiple Platter Hard Disk Drives

ABSOLUTE MAXIMUM RATINGS

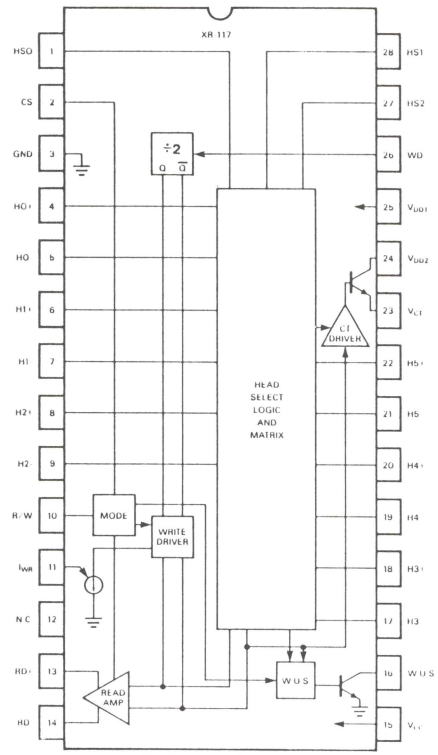
V_{DD1} and V_{DD2}	15 V
V_{CC}	6 V
Digital Inputs	−0.3 V to V_{CC} +0.3 V
Write Current	60 mA
Junction Temperature	150°C
Storage Temperature	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-117-2CP	Plastic	0°C to 70°C
XR-117-4CP	Plastic	0°C to 70°C
XR-117-6CP	Plastic	0°C to 70°C
XR-117-**x**CN	Ceramic	0°C to 70°C
XR-117-**x**CQ*	Surface Mount Quad	0°C to 70°C
XR-117-**x**MD*	Surface Mount	0°C to 70°C
XR-117-**x** *	PLCC	0°C to 70°C

x = 2, 4, or 6, depending on number of heads required
* = contact factory for availability

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

Four major blocks comprise the XR-117: a multiplexer for head selection, write data control circuitry, read signal amplifiers and buffers, and a power supply monitor that disables the device whenever improper supply voltages are present. Designed for six read/write heads, the XR-117 is also available in smaller packages for systems requiring only two or four heads. The 30 MHz minimum bandwidth facilitates data rates exceeding 25 Mbits per second.

Less than 2 $nV/\sqrt{Hz}$ (nominal) noise allows error free operation with small input signals. Up to 50 mA of write current output means the disk signal can be large, further enhancing the readback signal-to-noise ratio for very low error rates.

Cascading multiple XR-117s is accomplished by alternately enabling and disabling devices via the chip select (CS) pin. Guaranteed write current tolerances allow close write matching between devices.

Floppy Disk Write Amplifier

GENERAL DESCRIPTION

The XR-2247/2247A is a write amplifier designed to provide the complete interface between write data signals and tunnel-erase magnetic heads. Although primarily intended for floppy disk drive systems, the XR-2247/2247A can also be used in other magnetic media systems such as tape drives. To minimize external part count for dual head systems, complete head switching is does internally with emitter-coupled PNP transistors in the XR-2247 and diodes (which offer improved broadband noise characteristics) in the XR-2247A. Write and erase currents are each externally programmable with a single resistor. Also included is circuitry for inner track write current compensation. To prevent false write current outputs during power-on, an inhibit input has been provided. Erase turn-on and turn-off times are each externally programmable.

The XR-2247/2247A, available in a 22-Pin DIP, operates from a single power supply and provides TTL compatible inputs.

FEATURES

Fully Programmable Write and Erase Currents
Fully Programmable Erase Turn-on/Turn-off Times
Internal Head Switching for Dual Head Drives
Single Supply Operation
Inner Track Write Current Compensation
Inhibit Input
TTL Compatible Inputs
Low External Parts Count

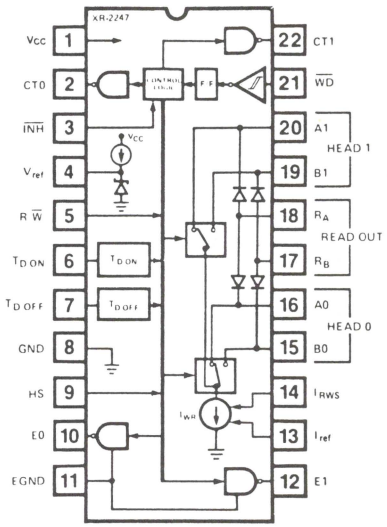
APPLICATIONS

Floppy Disk Drives
Single/Dual Head Systems
Magnetic Tape Write Amplifier

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage (Pin 1)	16 V dc
Input Voltage (all digital inputs)	−0.2V to +16 V dc
Reference Current (Pin 4)	10 mA dc
Output Current (Pins 2, 10, 12, 22)	100 mA dc
Storage Temperature	−55°C to +150°C
Operating Junction Temperature	150°C
Power Dissipation	750 mW
Derate Above 25°C	6.5 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2247CN	Ceramic	0°C to +70°C
XR-2247CP	Plastic	0°C to +70°C
XR-2247ACN	Ceramic	0°C to +70°C
XR-2247ACP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2247/2247A accepts a serial binary data stream input. With the write mode selected, negative transitions of this input signal will alternately provide write current to each half of the head. The XR-2247/2247A provides two sets of current outputs for dual head drives, with the head select (HS) control determining which is active. The write current is externally programmed with a resistor between the internal voltage reference and the current setting input. Two high-current open-collector outputs provide the erase coil drive. Turn-on and turn-off delay circuitry is provided for these outputs, with the delay externally programmed.

An inhibit input ($\overline{INH}$) is provided to disable the outputs to prevent false writing during power-on. With the read mode selected, internal head switching channels the proper head to the read outputs.

Floppy Disk Read/Write

GENERAL DESCRIPTION

The XR-3448 Floppy Disk Read/Write is a single 28 Pin monolithic solution for double-sided floppy disk drives. The device is compatible with 8", 5¼", and 3½" drives, providing all read and write functions and offering improved performance over industry standard dual chip sets, with lower external parts count. Schmitt trigger inputs and separate analog and power grounds aid noise and crosstalk immunity. Both pre and post amplifiers, plus an AGC, allow reliable operation with input signals ranging from 0.5 mV to 25mV.

The XR-3448 is available in standard or small outline 28 Pin packages. Control, write inputs, and read outputs are TTL compatible. The device operates from +12 V and +5 V supplies. The pinout is specially designed for similarity to the SSI-570 Read/Write, and in many applications, the XR-3448 acts as an improved version of that device.

FEATURES

All Read/Write Functions on a Single Chip
Schmitt Trigger Inputs for Noise Immunity
TTL Compatible
Power Up and Low Voltage Inhibit
Low Peak Shift – No Trimming Necessary
On Board AGC
Wide Read Dynamic Range
Low External Parts Count
All Delays RC Programmable
Separate Power and Signal Ground
Tunnel or Straddle Erase Compatibility

APPLICATIONS

Single or Dual Head Floppy Disk Drive Systems

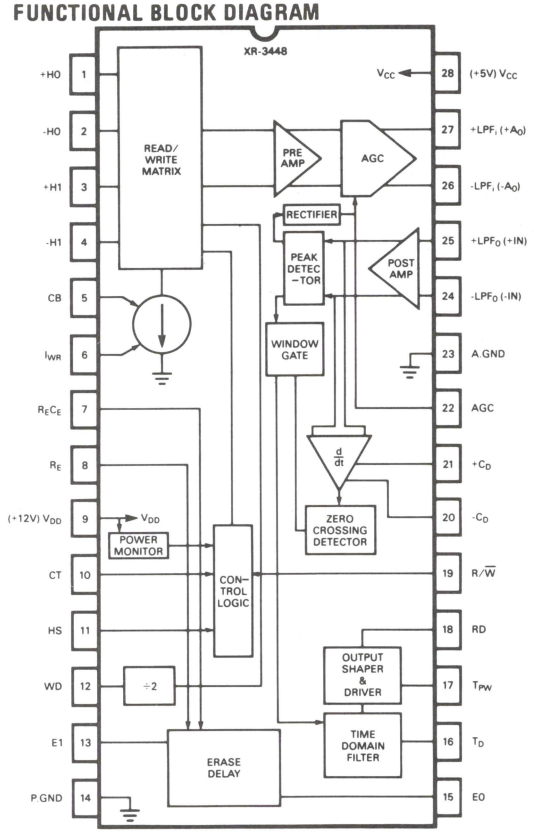
ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage	
Pin 28 (5 V)	7 V
Pin 9 (12 V)	15 V
Storage Temperature	-65°C to +150°C
Operating Junction Temperature	150°C
Power Dissipation (28 Pin DIL)	800 mW
Derate Above 25°C	6.5 mW/°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-3448CP	Plastic	0°C to +70°C
XR-3448CN	Ceramic	0°C to +70°C
XR-3448MD	Small Outline	0°C to +70°C
XR-3448CQ	Quad Surface Mount	0°C to +70°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-3448 Floppy Disk Read/Write is a high performance single chip solution for all standard floppy disk drives. TTL compatible control and interface levels, and +12 V and +5 V operation allows easy system implementation with standard components. An on-board voltage monitor, with hysteresis, supervises device voltage and disables all operation during power up and down. Dual grounds, one for the digital levels, the other for low level signals, and the use of ECL processing logic eliminates digital crosstalk and jittering coupled back into the read heads.

Read error reduction performance is greatly enhanced by the window gating logic that qualifies data pules and eliminates errors generated by noise or discontinuities during shouldering. A time domain filter further reduces errors caused by nonlinearities about data peaks. Together, these systems allow improved performance margins over simpler floppy disk read devices.

Floppy Disk Read Amplifier

GENERAL DESCRIPTION

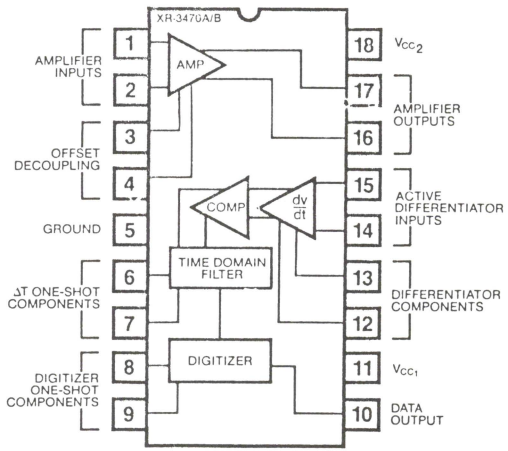
The XR-3470A/3470B is read amplifier system designed primarily for use in a floppy disk drive system. It is designed to perform the complete readback function, by accepting the readback signal from a magnetic head and converting it into digital output pulses. To perform this function, the circuit contains a high-frequency amplifier, an active differentiator, a zero-crossing detector, and a time domain filter.

The XR-3470A/3470B is suited for systems with data transfer rates up to 3 megabaud. High input sensitivity allows operation with signal levels as low as 1.4 mV pp, which gives it the flexibility to be used for single or double density floppy disk systems.

The XR-3470A/3470B offers improvements (over the standard 3470) of lower peak shift and power part-to-part input amplifier gain variations.

The XR-3470A/3470B, available in an 18 Pin DIP, is powered by +5 and +12 volt power supplies.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Complete Floppy Disk Read Amplifier	
Low Input Voltage detection	1.4 mV pp
Low Peak Shift 3470A	2% Max
3470B	4% Max
Low Amplifier Gain Variation	100 V/V Min
	130 V/V Max
High Amplifier Frequency Response	10 MHz, Min.

APPLICATIONS

Single/Double Density Floppy Disk Read Amplifier
Magnetic Read Amplifier

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage (Pin 11)	7 V dc
Power Supply Voltage (Pin 18)	16 V dc
Input Voltage (Pins 1 and 2)	−2V to +7 V dc
Output Voltage (Pin 10)	−2V to +7 V dc
Operating Ambient Temperature	0°C to +70°C
Storage Temperature	−65°C to +150°C
Operating Junction Temperature	150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-3470ACN	Ceramic	0°C to +70°C
XR-3470ACP	Plastic	0°C to +70°C
XR-3470BCN	Ceramic	0°C to +70°C
XR-3470BCP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-3470A/3470B contains four internal signal blocks. Their functions are as follows: **Input Amplifier** — This section receives an input directly from the magnetic head. It provides a nominal gain of 110 V/V, with gain select pins to reduce gain or tailor it for ac response. The amplifier has differential inputs and outputs. **Active Differentiator** — This circuit differentiates the signal from the amplifier which causes a zero-crossing for each peak of the readback signal. The time constant and response of this section is externally set. **Zero-Crossing Detector** — This function is performed by a voltage comparator. It produces complementary outputs for the internal digital section. **Digital Section** — This section consists of 2 one-shots and other control circuitry. The one-shots are used to prevent false outputs, and set the output pulse width.

Floppy Disk Write Amplifier

GENERAL DESCRIPTION

The XR-3471 is a write amplifier designed to provide the complete interface between write data signals and tunnel and straddle erase magnetic heads. Although primarily intended for floppy disk drive systems, the XR-3471 can also be used in other magnetic media systems such as tape drives. Write and erase currents are each externally resistor programmable. Also included is circuitry for inner track write current compensation.

The XR-3471, available in a 20 pin DIP or small outline package, provides TTL compatible inputs. Tunnel erase delays are determined by external reistors and capacitors.

FEATURES

Fully Programmable Write & Erase Currents
Fully Programmable Erase Turn-on/Turn-off Times
(Tunnel and Straddle Erase Compatibility)
Inhibit Output
TTL Compatible Inputs
Direct Replacement for Motorola MC3471

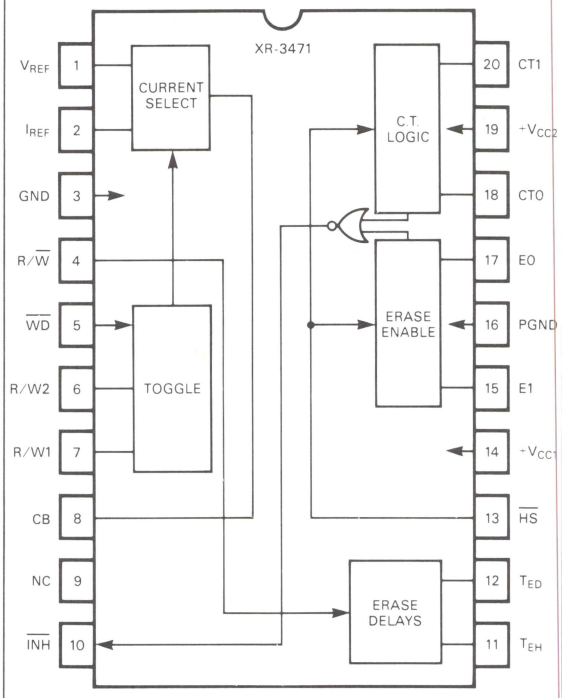
APPLICATIONS

Floppy Disk Drives
Magnetic Tape Write Amplifier

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage, V_{CC} 2	30 V dc
V_{CC} 1	7.0 V dc
Input Voltage (All Digital Inputs)	−0.2 V to +5.75 V dc
Output Current	100 mA dc
Storage Temperature	-55°C to +150°C
Power Dissipation	
Plastic Package	650 mW
Derate Above 25°C	5.0 mW/°C
Ceramic Package	1 W
Derate Above 25°C	8.0 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-3471CN	Ceramic	0°C to +70°C
XR-3471CP	Plastic	0°C to +70°C
XR-3471MD	Small Outline	0°C to +70°C

SYSTEM DESCRIPTION

The XR-3471 accepts a serial binary data stream input. With the write mode selected, negative transitions of this input signal will alternately provide write current to each half of the head. The write current is externally programmed with a resistor between the internal voltage reference and the current setting input. A high-current open collector output provides the erase coil drive. Turn-on and turn-off delay circuitry is provided, with the delay externally programmed.

EXAR

Section 5—Industrial Circuits

Dual Bipolar JFET Operational Amplifier

GENERAL DESCRIPTION

The XR-082/XR-083 family of dual bipolar JFET operational amplifiers are designed to offer higher performance than conventional bipolar op amps. Each amplifier features high slew rate, low input bias and offset currents, and low offset voltage drift with temperature. These operational amplifier circuits are fabricated using ion-implantation technology which combines well-matched junction JFETs and high-performance bipolar transistors on the same monolithic chip.

The XR-082 of family of dual bipolar JFET op amps are packaged in 8-pin dual-in-line packages. The XR-083 family of op amps offer independent offset adjustment for each of the individual op amps on the same chip, and are available in 14-pin dual-in-line packages.

FEATURES

Direct Replacement for TL082/TL083
Low Power Consumption
Wide Common-Mode and Differential Voltage Ranges
Low Input Bias and Offset Currents
Output Short Circuit Protection
High Input Impedance . . JFET Input Stage
Internal Frequency Compensation
Latch-Up-Free Operation
High Slew Rate . . 13 V/μs, Typical

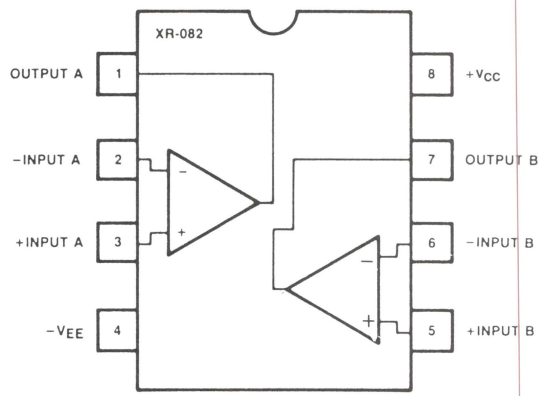
APPLICATIONS

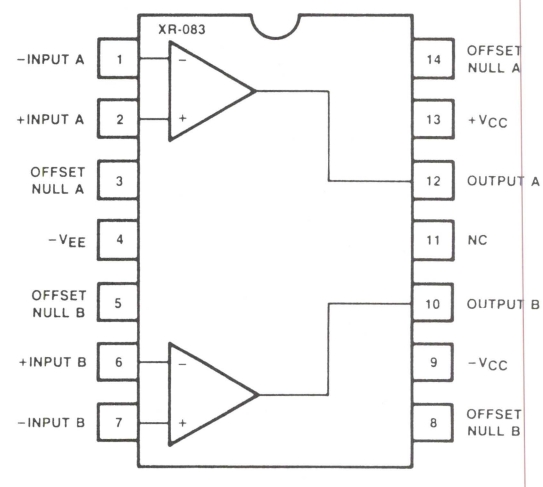
Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Differential Input Voltage	±30V
Input Voltage Range (Note 1)	±15V
Output Short Circuit Duration (Note 2)	Indefinite
Package Power Dissipation:	
Plastic Package	625 mW
Derate Above T_A = +25°C	5.0 mW°C
Ceramic Package	750 mW
Derate Above T_A = +25°C	6.0 mW/°C
Storage Temperature Range	−65°C to + 150°C

FUNCTIONAL BLOCK DIAGRAMS





ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-082M/XR-083M	Ceramic	−55°C to +125°C
XR-082N/XR-083N	Ceramic	−25°C to + 85°C
XR-082P/XR-083P	Plastic	−25°C to + 85°C
XR-082CN/XR-083CN	Ceramic	0°C to + 70°C
XR-082CP/XR-083CP	Plastic	0°C to + 70°C

Quad Bipolar JFET Operational Amplifier

GENERAL DESCRIPTION

The XR-084 quad bipolar JFET operational amplifier is designed to offer higher performance than conventional bipolar quad op amps. Each of the four op amps on the chip is closely matched in performance characteristics, and each amplifier features high slew rate, low input bias and offset currents, and low offset voltage drift with temperature. The XR-084 JFET input quad op amp is fabricated using ion-implanted bipolar JFET technology which combines well-matched JFETs and high-performance bipolar transistors on the same monolithic integrated circuit.

FEATURES

Direct Replacement for TL084
Same Pin Configuration as XR-3403, LM324
High-Impedance JFET Input Stage
Internal Frequency Compensation
Low Power Consumption
Wide Common-Mode and Differential Voltage Ranges
Low Input Bias and Offset Currents
Output Short Circuit Protection
Latch-Up-Free Operation
High Slew Rate . . . 13 V/μS, Typical

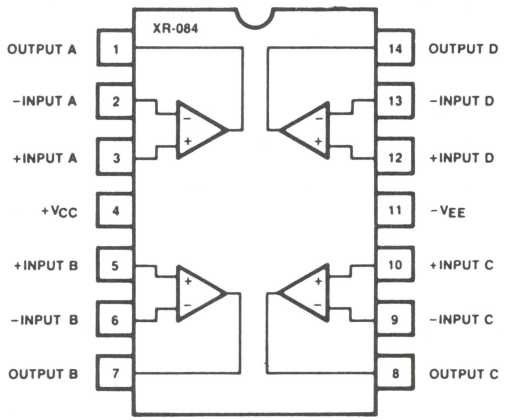
APPLICATIONS

Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Differential Input Voltage	±30V
Input Voltage Range (Note 1)	±15V
Output Short Circuit Duration (Note 2)	Indefinite
Package Power Dissipation:	
Plastic Package	625 mW
Derate Above T_A = +25°C	5.0 mW/°C
Ceramic Package	750 mW
Derate Above T_A = +25°C	6.0 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-084M	Ceramic	−55°C to +125°C
XR-084N	Ceramic	−25°C to + 85°C
XR-084P	Plastic	−25°C to + 85°C
XR-084CN	Ceramic	0°C to + 70°C
XR-084CP	Plastic	0°C to + 70°C

SYSTEM DESCRIPTION

The XR-084 is a quad JFET input operational amplifier featuring extremely high input resistance, low input bias and offset currents, large common mode voltage range, and large output swing range. Unity gain bandwidth is 3 MHz and slew rate is 13V/μS. The devices are unity gain compensated.

Quad Programmable Bipolar JFET Operational Amplifiers

GENERAL DESCRIPTION

The XR-094 and XR-095 bipolar JFET input quad programmable operational amplifiers consist of four independent, high gain, internally compensated amplifiers. Two external resistors (R_{SET}) allow the user to program supply current, slew-rate, and input noise without the usual sacrifice of gain bandwidth product. For example, the user can trade-off slew-rate for supply current or optimize the noise figure for a given source impedance. Except for the two programming pins at the end of the package, the XR-094 and XR-095 pin-out is the same as the popular 324, 3403, 124, 148 and 4741 operational amplifiers.

In the case of the XR-094, three of the op amps on the chip share a common programming pin; and the fourth op amp is programmed separately. In the case of the XR-095, each pair of op amps share a common programming pin.

FEATURES

Same Pin Configuration as LM-346
High-Impedance FET Input Stage
Internal Frequency Compensation
Low Power Consumption
Wide Common-Mode and Differential Voltage Ranges
Low Input Bias and Offset Currents
Output Short-Circuit Protection
High Slew-Rate . . . 13 V/μs, Typical
Programmable Electrical Characteristics

APPLICATIONS

Total Supply Current = 5.6 mA (I_{SET}/320 μA)
Slew Rate = 13 V/μs (I_{SET}/320 μA)
I_{SET} = Current into set terminal

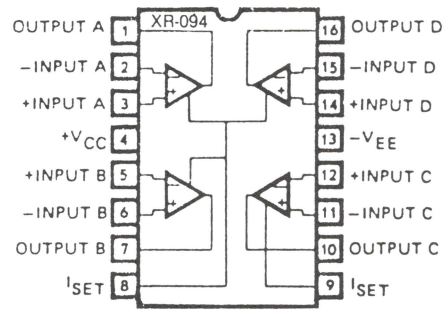
$$I_{SET} = \frac{V_{CC} - (V_{EE} - 0.6V)}{R_{SET}}$$

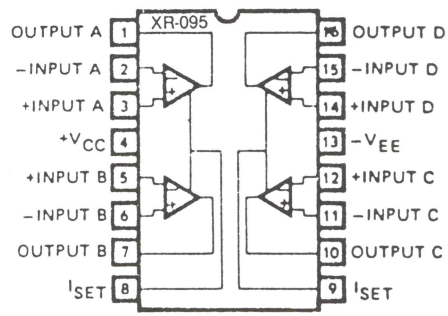
Note. I_{SET} must be $\leq$ 400μA

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Differential Input Voltage	±30V
Input Voltage Range (Note 1)	±15V
Output Short-Circuit Duration (Note 2)	Indefinite
Package Power Dissipation:	
Plastic Package	625 mW

FUNCTIONAL BLOCK DIAGRAMS





ABSOLUTE MAXIMUM RATINGS (Continued)

Derate Above T_A = +25°C	5.0 mV/°C
Ceramic Package	750 mW
Derate Above T_A = +25°C	6.0 mW/°C
Storage Temperature Range	−65°C to +150°C

Note 1: For Supply Voltage less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 2: The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-094/XR-095N	Ceramic	−25°C to +85°C
XR-094/XR-095P	Plastic	−25°C to +85°C
XR-094/XR-095CN	Ceramic	0°C to +70°C
XR-094/XR-095CP	Plastic	0°C to +70°C

Quad Programmable Bipolar JFET Operational Amplifier

GENERAL DESCRIPTION

The XR-096 monolithic circuit contains four independently programmable JFET operational amplifiers in a single IC package. Each of the four op amp sections on the chip has its own external bias terminal; thus its performance characteristics and power dissipation can be independently controlled, without effecting the other op amp sections on the chip. The respective bias-setting resisters, R_{SET}, connected to the programming terminals of the circuit allow one to trade-off power dissipation for slew-rate, without sacrificing the gain-bandwidth product of the circuit. These individual bias terminals can also be used to switch the op amp sections "on" and "off", and thus, multiplex between various op amp channels on the same chip.

FEATURES

Programmable Version of XR-084
Independent Programming of All Four Op Amps
Programmable for Micropower Operation
High-Impedance JFET Input Stage
Internal Frequency Compensation
Low Input Bias and Offset Currents

APPLICATIONS

Total Supply Current = 5.6 mA (I_{SET}/320 μA)
Slew-Rate = 13 V/μs (I_{SET}/320 μA)
I_{SET} = Current into set terminal

$$I_{SET} = \frac{V_{CC} - (V_{EE} - 0.6V)}{R_{SET}}$$

Note. I_{SET} must be $\leq$ 400μA

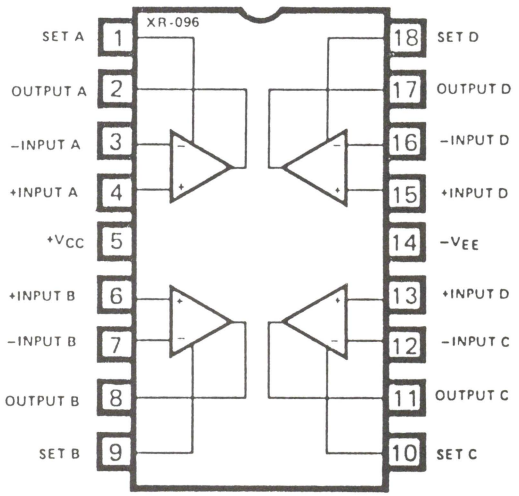
ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Differential Input Voltage	±30V
Input Voltage Range (Note 1)	±15V
Output Short-Circuit Duration (Note 2)	Indefinite
Package Power Dissipation:	
Plastic Package	625 mW
Derate Above T_A = +25°C	5.0 mV/°C
Ceramic Package	750 mW
Derate Above T_A = +25°C	6.0 mW/°C
Storage Temperature Range	−65°C to +150°C

Note 1: For Supply Voltage less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 2: The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-096N	Ceramic	−25°C to +85°C
XR-096P	Plastic	−25°C to +85°C
XR-096CN	Ceramic	0°C to +70°C
XR-096CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-096 is a quad independently programmable JFET input operational amplifier featuring extremely high input resistance, low input bias and offset current, large common mode voltage range, and large output swing range. Unity gain bandwidth is 3 MHz, and slew rate is 13V/μS. The devices are unity gain compensated.

Each of the form amplifiers may be independently "programmed"-rebiased-by connecting a resistor from the bias adjust pin to the positive supply. Bias current may range up to 400 μA, thus affording the designer flexibility along the power consumption/speed curve.

Programmable Quad Operational Amplifiers

GENERAL DESCRIPTION

The XR-146 family of quad operational amplifiers contain four independent high-gain, low-power, programmable op-amps on a monolithic chip. The use of external bias setting resistors permit the user to program gain-bandwidth product, supply current, input bias current, input offset current, input noise and the slew rate.

The basic XR-146 family of circuits offer partitioned programming of the internal op-amps where one setting resistor is used to set the bias levels in the three op-amps, and a second bias setting is used for the remaining op-amp. Its modified version, the XR-346-2 provides a separate bias setting resistor for each of the two op-amp pairs.

FEATURES

Programmable
Micropower operation
Low noise
Wide power supply range
Class AB output
Ideal pin out for biquad active filters
Overload protection for input and output
Internal frequency compensation

APPLICATIONS

Total Supply Current = 1.4 mA (I_{SET}/10 μA)
Gain Bandwidth Product = 1 MHz (I_{SET}/10μA)
Slew Rate = 0.4V/μs (I_{SET}/10 μA)
Input Bias Current $\cong$50 nA (I_{SET}/10 μA)

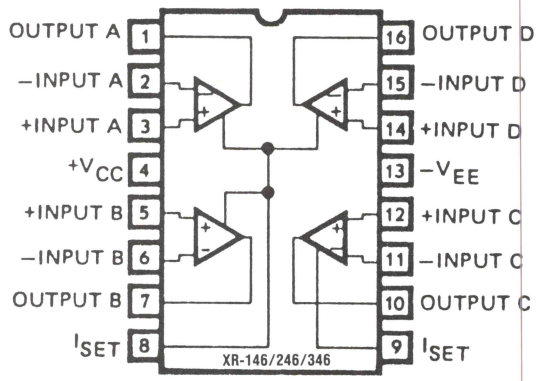
I_{SET} = Current into pin 8, pin 9 (see schematic)

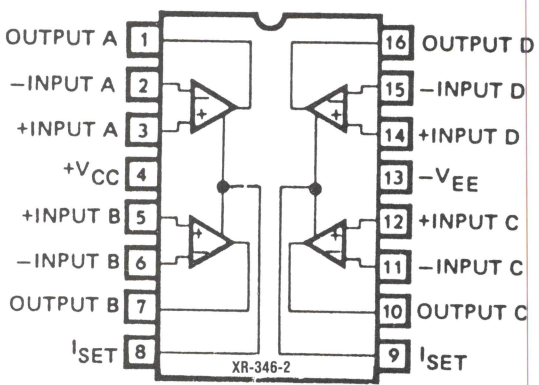
$$I_{SET} = \frac{V+ - V- - 0.6V}{R_{SET}}$$

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-146	±22V
XR-246/346	±18V
Differential Input Voltage (Note 1)	
XR-146/246/346	±30V
Common Mode Input Voltage (Note 1)	
XR-146/246/346	±15V
Power Dissipation (Note 2)	
XR-146	900 mW
XR-246/346	500 mW
Output Short Circuit Duration (Note 3)	
XR-146/246/346	Indefinite
Maximum Junction Temperature	
XR146	150°C
XR-246	110°C
XR-346	100°C

FUNCTIONAL BLOCK DIAGRAMS





ABSOLUTE MAXIMUM RATINGS (continued)

Storage Temperature Range	
XR-146/246/346	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-146M	Ceramic	−55°C to +125°C
XR-246N	Ceramic	−25°C to +85°C
XR-246P	Plastic	−25°C to +85°C
XR-346/ 346-2CN	Ceramic	0°C to +70°C
XR-346/ 346-2CP	Plastic	0°C to +70°C

Dual Operational Amplifier

GENERAL DESCRIPTION

The XR-1458/4558 is a pair of independent internally compensated operational amplifiers on a single silicon chip, each similar to the popular 741, but with a power consumption less than one 741. Good thermal tracking and matched gain-bandwidth products make these Dual Op-amps useful for active filter applications.

FEATURES

Direct Pin-for-Pin Replacement for MC1458, RC4558, N5558
Low Power Consumption — 50 mW typ. and 120mW max.
Short-Circuit Protection
Internal Frequency Compensation
No Latch-Up
Wide Common-Mode and Differential Voltage Ranges
Matched Gain-Bandwidth

APPLICATIONS

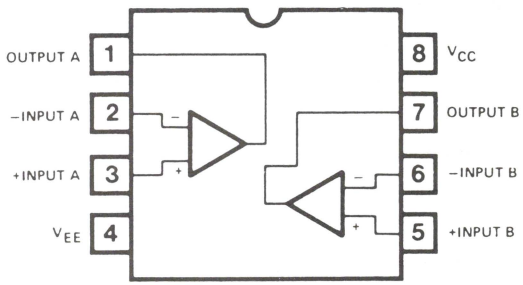
Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-4558CP	±18V
Input Voltage (Note 1)	±15V
Common Mode	
Voltage Range	V_{EE} to V_{CC}
Output Short-Circuit Duration (Note 2)	indefinite
Differential Input Voltage	±30V
Internal Power Dissipation (Note 3)	
Plastic Package:	500 mW
Storage Temperature Range:	−65°C to +150°C
Operating Temperature Range:	0°C to +70°C

Note 1: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
Note 2: Short circuit may be to ground or either supply. Rating applies to +125°C case temperature of +75°C ambient temperature for XR1458/4558.
Note 3: Rating applies for case temperatures to 125°C; derate linearly at 6.5mW/°C for ambient temperatures above +75°C for XR1458/4558.

FUNCTIONAL BLOCK DIAGRAM



5

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1458CN	Ceramic	0°C to +70°C
XR-1458CP	Plastic	0°C to +70°C
XR-4558CN	Ceramic	0°C to +70°C
XR-4558CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-1458 and XR-4558 are dual general purpose op amps featuring better performance than industry standard devices such as the 741; bandwidth, slew rate, and input resistance are greatly improved. Internal protection circuitry includes latch-up elimination, short circuit current limiting, and internal compensation.

The two amplifiers are completely independent, sharing bias circuitry only.

Quad Operational Amplifiers

GENERAL DESCRIPTION

The XR-3403 and XR-3503 are quad operational amplifiers specifically designed for single supply operation. All four amplifiers are similar in characteristics to industry standard op amps like the 741. The XR-3403 is available in both ceramic and plastic packages; the XR-3503 is available in a 14 pin ceramic package with guaranteed performances across the military temperature range.

FEATURES

Short Circuit Protected Outputs
Class AB Output Stage for Minimal Crossover Distortion
True Differential Input Stage
Single Supply Operation: 3.0 to 36 Volts
Split Supply Operation: ±1.5 to ± 18 Volts
Low Input Bias Currents: 500 nA Max
Four Amplifiers per Package
Internally Compensated
Similar Performance to Popular 741
Direct Pin-for-Pin Replacement for MC3403/3503, LM324 and RC4137

APPLICATIONS

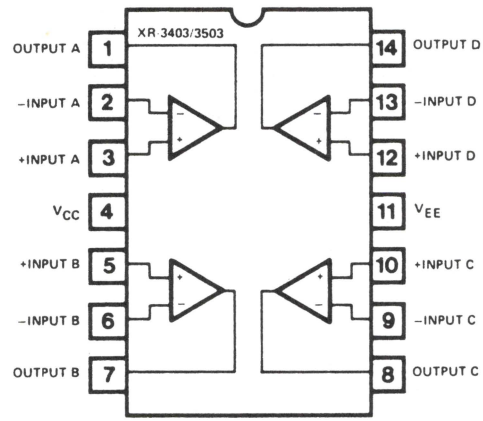
Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltages	
Single Supply	36V
Split Supplies	±18V
Input Differential Voltage Range with Split Power Supply	±30V
Input Common Mode Voltage Range*	±15V
Package Power Dissipation:	
Plastic Package	625 mW
Derate above T_A = +25°C	5.0 mV/°C
Ceramic Package	750 mW
Derate above T_A = +25°C	6.0 mW/°C
Storage Temperature Range	−65°C to +150°C

*For Supply Voltage less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-3503M	Ceramic	−55°C to +125°C
XR-3403CN	Ceramic	0°C to +70°C
XR-3403CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-3403 is an array of four independent operational amplifiers, each with true differential inputs. The device has electrical characteristics similar to the popular 741. However, the XR-3403 has several distinct advantages over standard operational amplifier types in single supply applications. The XR-3403 can operate at supply voltages as low as 3.0 volts or as high as 36 volts with quiescent currents about one-fifty of those associated with the 741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

Quad Operational Amplifier

GENERAL DESCRIPTION

The XR-4136 is an array of four independent internally compensated operational amplifiers on a single silicon chip, each similar to the popular 741. Good thermal tracking and matched gain-bandwidth products make these Quad Op-amps useful for active filter applications.

FEATURES

Direct Pin-for-Pin Replacement for RC4136 and RM4136
Short-Circuit Protection
Internal Frequency Compensation
No Latch-Up
Wide Common-Mode and Differential Voltage Ranges
Matched Gain-Bandwidth

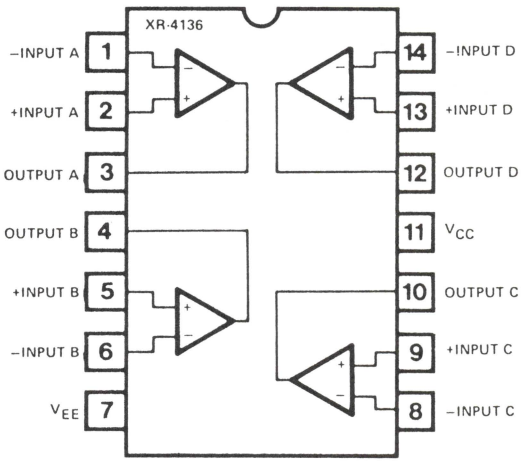
APPLICATIONS

Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-4136M	±22V
XR-4136C	±18V
Common Mode	
Voltage Range	V_{EE} to V_{CC}
Output Short-Circuit Duration	Indefinite
Differential Input Voltage	±30V
Internal Power Dissipation	
Ceramic Package:	750 mW
Derate above T_A = +25°C	6 mW/°C
Plastic Package:	625 mW
Derate above T_A = +25°C	5 mW/°C
Storage Temperature Range:	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4136M	Ceramic	−55°C to +125°C
XR-4136CN	Ceramic	0°C to +70°C
XR-4136CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-4136 is a quad operational amplifier featuring similar characteristics to standard 741-type devices. As all four are monolithic, they have matched characteristics, including thermal tracking and gain bandwidth products.

Programmable Quad Operational Amplifier

GENERAL DESCRIPTION

The XR-4202 is an array of four independent operational amplifiers on a single silicon chip. The operating current of the array is externally controlled by a single resistor or current source, allowing the user to trade-off power dissipation for bandwidth.

FEATURES

Programmable
Micropower Operation
Wide Input Voltage and Common Mode Range
Internal Frequency Compensation
No Latch-Up
Matched Parameters
Short-Circuit Protection

APPLICATIONS

The following approximate relations are useful for design:

Gain-Bandwidth Product	≈	50 I_{SET}	(kHz)
Power Supply Current	≈	30 I_{SET}	(μA)
Slew Rate	≈	20 I_{SET}	(V/ms)

Where: I_{SET} is in μA

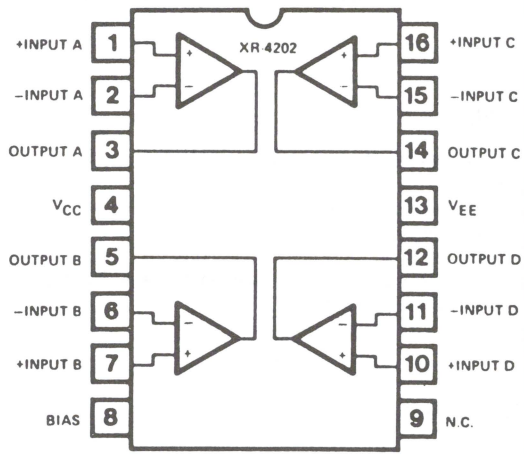
$$I_{SET} = \frac{V_{EE} - V_{BE}}{R_{SET}}$$

WHERE V_{BE} DIODE VOLTAGE ≈ 0.65V

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Differential Input Voltage	±30V
Power Dissipation	
Ceramic Package:	750 mW
Derate above T_A = +25°C	6 mW/°C
Plastic Package:	625 mW
Derate above T_A = +25°C	5 mW/°C
Common Mode Range	V_{EE} to V_{CC}
Short Circuit Duration	Indefinite
Storage Temperature	−60°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4202N	Ceramic	−40°C to +85°C
XR-4202P	Plastic	−40°C to +85°C

SYSTEM DESCRIPTION

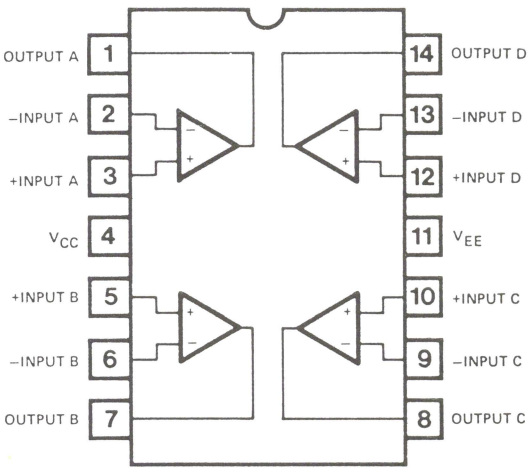
The XR-4202 is a quad independently programmable operational amplifier featuring improved performance over industry standard devices such as the 741. Amplifier bias currents can be "programmed" by a single resistor to Pin 8. Bias currents can range from less than 1μA, thus affording the designer flexibility along the device speed/power consumption trade off curve.

Quad Operational Amplifier

GENERAL DESCRIPTION

The XR-4212 is an array of four independent internally compensated operational amplifiers on a single silicon chip, each similar to the popular 741, but with a power consumption less than one 741. Good thermal tracking and matched gain-bandwidth products make these Quad Op-amps useful for active filter applications.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Same Pinout as MC3403 and LM324
Low Power Consumption—50 mW typ. and 120mW max.
Short-Circuit Protection
Internal Frequency Compensation
No Latch-Up
Wide Common-Mode and Differential Voltage Ranges
Matched Gain-Bandwidth

APPLICATIONS

Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4212M	Ceramic	−55°C to +125°C
XR-4212CN	Ceramic	0°C to +70°C
XR-4212CP	Plastic	0°C to +70°C

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-4212M	±22V
XR-4212C	±18V
Common Mode Voltage	V_{EE} to V_{CC}
Output Short-Circuit Duration	Indefinite
Differential Input Voltage	±30V
Internal Power Dissipation	
Ceramic Package:	750 mW
Derate above T_A = +25°C	6 mW/°C
Plastic Package:	625 mW
Derate above T_A = +25°C	5 mW/°C
Storage Temperature Range:	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-4212 is a quad operational amplifier featuring improved performance over industry standard devices such as the 741.

Dual Low Noise Operational Amplifier

GENERAL DESCRIPTION

The XR-4560 is a dual low noise, wide bandwidth operational amplifier ideal for active filter applications. The device is similar to the XR-1458/4558, with greatly enhanced slew rate, bandwidth, and guaranteed noise characteristics.

Pin for pin compatibility allows direct substitution for industry standard dual op amps where the low noise and wide bandwidth of the XR-4560 is imperative.

FEATURES

High Gain, Low Input Noise
Internally Compensated
Wide Small Signal Bandwidth
Interchangeable with General Purpose Dual Op Amps

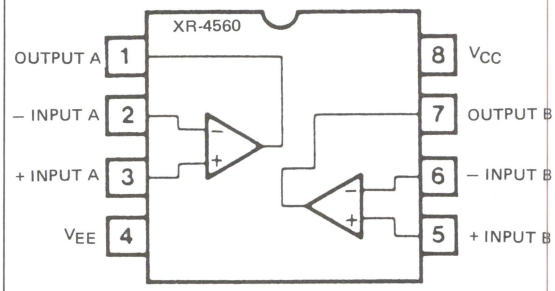
APPLICATIONS

High Gain, Low Noise Amplifier
High Performance Active Filter
Small Signal Amplifier
Servo Control System
Telephone Channel Amplifier

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18 V
Power Dissipation	500 mW
Derate Above at 25°C	5 mW/°C
Operating Temperature	0°C to +70°C
Storage Temperature	-55°C to +125°C
Differential Input Voltage	±30 V
Common Mode Range	V_{EE} to V_{CC}

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4560CP	Plastic	0°C to 70°C
XR-4560CN	Ceramic	0°C to 70°C
XR-4560MD	SO-8	0°C to 70°C

SYSTEM DESCRIPTION

The XR-4560 dual op amp offers guaranteed low noise and a 10 MHz small signal bandwidth. Slew rate typically exceeds 4 V/μS. Internal protection circuitry includes latch-up elimination, short circuit current limiting, and internal compensation.

The two amplifiers are completely independent, sharing only power supply connections.

Dual Low Noise Operational Amplifier

GENERAL DESCRIPTION

The XR-4739 is a monolithic dual op amp featuring low noise and a large gain bandwidth product. The device is ideal for preamplifiers, signal processing equipment, and active filters.

FEATURES

Internally Compensated Replacement for μA 739 and MC1303
Signal-to-Noise Ratio 76dB (RIAA 10 mV ref.)
Channel Separation 125dB
Unity Gain Bandwidth 3MHz
Output Short-circuit Protected
0.1% Distortion at 8.5V RMS Output into 2KΩ Load

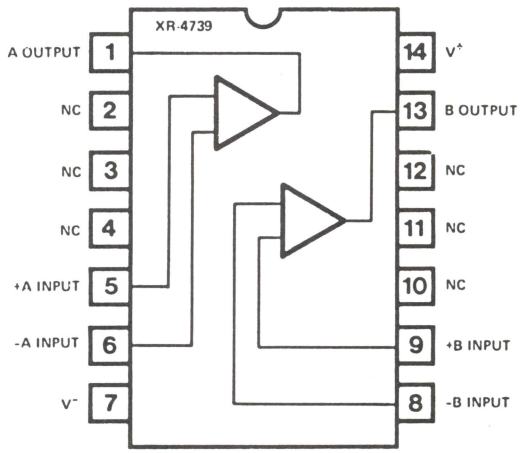
APPLICATIONS

Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Internal Power Dissipation (Note 1)	500 mW
Differential Input Voltage	±30V
Input Voltage (Note 2)	±15V
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60s)	300°C
Output Short-Circuit Duration (Note 3)	Indefinite

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4739CN	Ceramic	0°C to +70°C
XR-4739CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-4739 dual low noise operational amplifier is fabricated on a single silicon chip using the planar epitaxial process. It was designed primarily for preamplifiers in consumer and industrial signal processing equipment. The device is pin compatible with the μA739 and MC1303, however, compensation is internal. This permits a lowered external parts count and simplified application.

The XR-4739 is available in a ceramic or molded dual inline 14 Pin package, and operates over the commercial temperature range from 0°C to +70°C.

Quad Operational Amplifier

GENERAL DESCRIPTION

The XR-4741 is an array of four independent internally-compensated operational amplifiers on a single silicon chip, each similar to the popular 741. Each amplifier offers performance equal to or better than the 741 type in all respects. It has high slew rate, superior bandwidth, and low noise, which makes it excellent for audio amplifiers or active filter applications.

FEATURES

Short-Circuit Protection
Internal Frequency Compensation
No Latch-Up
Wide Common-Mode and Differential Voltage Ranges
Matched Gain-Bandwidth

High Slew Rate	1.6V/μS(Typ)
Unity Gain-Bandwidth	3.5 MHz(Typ)
Low Noise Voltage	9 nV$\sqrt{Hz}$
Input Offset Current	60 nA(Typ)
Input Offset Voltage	.5 mV(Typ)
Supply Range	$\pm$2V to $\pm$20V

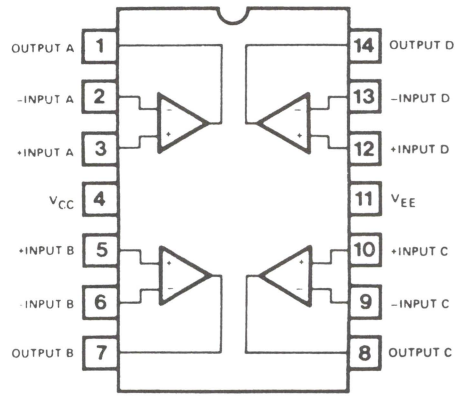
APPLICATIONS

Buffer Amplifiers
Summing/Differencing Amplifiers
Instrumentation Amplifiers
Active Filters
Signal Processing
Sample and Differencing
I to V Converters
Integrators
Simulated Components
Analog Computers

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-4741	$\pm$20
Common Mode Voltage	V_{EE} to V_{CC}
Output Short-Circuit Duration	Indefinite
Differential Input Voltage	$\pm$30V
Internal Power Dissipation	
Ceramic Package:	880 mW
Derate above T_A = +25°C	5.8 mW/°C
Plastic Package:	625 mW
Derate above T_A = +25°C	5 mW/°C
Storage Temperature Range:	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4741M	Ceramic	−55°C to +125°C
XR-4741CN	Ceramic	0°C to +70°C
XR-4741CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-4741 is a quad independently programmable operational amplifier featuring improved performance over industry standard devices such as the 741. Amplifier bias currents can be "programmed" by a single resistor to Pin 8. Bias currents can range from less than 1 μA to over 75 μA, thus affording the designer flexibility along the device speed/power consumption trade off curve.

Dual Low Noise Operational Amplifier

GENERAL DESCRIPTION

The XR-5532 dual low noise operational amplifier is especially designed for applications in high quality professional audio equipment. The low noise, wide bandwidth and output drive capability make it ideally suited for instrumentation and control circuits as well as active filter design.

The XR-5532A is the specially screened version of the XR-5532, with guaranteed noise characteristics.

FEATURES

Pin for Pin Replacement for Signetics NE 5532
Wide Small-Signal Bandwidth: 10 MHz
High-Current Drive Capability
(10V rms into 600Ω at VS = ±18V)
High Slew Rate: 9 V/μs 140
Wind Power-Bandwidth: 140 kHz
Very Low Input Noise: 5 nV/√Hz
Wide Supply Range: ±3V to ±20V

APPLICATIONS

High Quality Audio Amplification
Telephone Channel Amplifier
Servo Control Systems
Low-Level Signal Detection
Active Filter Design

ABSOLUTE MAXIMUM RATINGS

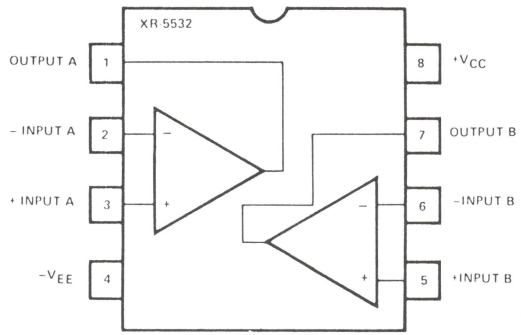
Power Supply	±22V
Input Common-Mode Range	$-V_{EE}$ to $+V_{CC}$
Differential Input Voltage (Note 1)	±0.5V
Power Dissipation (Package Limitation)	
Ceramic Package 8-Pin	600 mW
Derate Above TA = 25°C	8 mW/°C
Storage Temperature	−60°C to +150°C

Note 1: Diodes protect the inputs against over-voltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6V. Maximum current should be limited to ± 10 mA.

Note 2: Output may be shorted to ground at $V_{CC} = V_{EE} =$ 15V, $T_A = 25°C$. Temperature and/or voltages must be limited to ensure dissipation rating is not exceeded.

Note 3: Operation near the absolute maximum ratings will exceed the power dissipation of the package.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-5532N	Ceramic	0°C to +70°C
XR-5532P	Plastic	0°C to +70°C
XR-5532AN	Ceramic	0°C to +70°C
XR-5532AP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-5532 and XR-5532A are dual monolithic operational amplifiers featuring low noise and very large gain bandwidth products. The devices have low output resistance and can drive 10 Vrms into 600Ω. Input noise is 100% tested on the XR-5532A, and is typically only 5 nV/√Hz. The small signal bandwidth is 10 MHz and slew rate exceeds 9 V/μS. Supply voltage may range from ± 3V to ± 18V.

Dual Low Noise Operational Amplifier

GENERAL DESCRIPTION

The XR-5533 dual low noise operational amplifier is especially designed for applications in high quality professional audio equipment. The low noise, wide bandwidth and output drive capability make it ideally suited for instrumentation and control circuits as well as active filter design.

The XR-5533A is the specially screened version of the XR-5533 with guaranteed worst-case noise specifications.

FEATURES

Direct Replacement for Signetics SE/NE 5533
Wide Small-Signal Bandwidth: 10 MHz
High-Current Drive Capability
(10V rms into 600Ω at $V_S = \pm 18V$)
High Slew Rate: 13 V/μs
Wide Power-Bandwidth: 200 kHz
Very Low Input Noise: 4 nV/√Hz

APPLICATIONS

High Quality Audio Amplification
Telephone Channel Amplifier
Servo control Systems
Low-Level Signal Detection
Active Filter Design

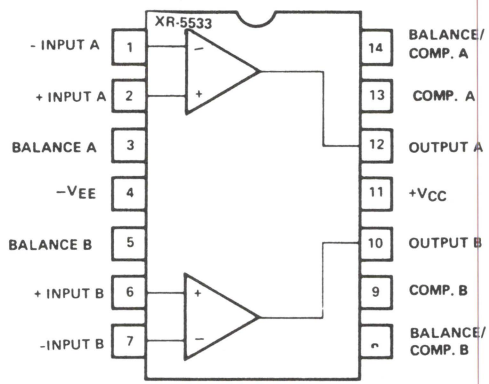
ABSOLUTE MAXIMUM RATINGS

Power Supply	±22V
Input Common-Mode Range	$-V_{EE}$ to $+V_{CC}$
Differential Input Voltage (Note 1)	±0.5V
Short Circuit Duration (Note 2)	Indefinite
Power Dissipation (Package Limitation)	
Ceramic Package 14-Pin	750 mW
Plastic Package 14-Pin	600 mW
Derate Above $T_A = 25°C$	5 mW/°C
Storage Temperature	−60°C to +150°C

Note 1: Diodes protect the inputs against over-voltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6V. Maximum current should be limited to ± 10 mA.

Note 2: Output may be shorted to ground at $V_{CC} = V_{EE} = 15V$, $T_A = 25°C$. Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-5533AN	Ceramic	0°C to +70°C
XR-5533AP	Plastic	0°C to +70°C
XR-5533N	Ceramic	0°C to +70°C
XR-5533P	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-5533 and XR-5533A are dual monolithic operational amplifiers featuring low noise and very large gain bandwidth products. The devices have low output resistance and can drive 10 Vrms into 600Ω. Input noise is 100% tested on the XR-5533A, and is typically only 4 nV/√Hz. The small signal bandwidth is 10 MHz and slew rate exceeds 13 V/μS.

Low Noise Operational Amplifier

GENERAL DESCRIPTION

The XR-5534 is a high performance low noise operational amplifier especially designed for application in high quality and professional audio equipment. It offers five-fold improvement in noise characteristics, output drive capability and full-power bandwidth over conventional 741-type op amps. The op amp is internally compensated for gain equal to, or higher than, three. The frequency response can be optimzed with an external compensation capacitor for various applications such as operating in unity gain mode or driving capacitive loads.

The XR-5534A is a specially-screened version of the XR-5534, with guaranteed noise specifications.

FEATURES

Direct Replacement for Signetics NE/SE 5534
Wide Small-Signal Bandwidth: 10 MHz
High-Current Drive Capability
(10V rms into 600Ω at $V_S = \pm 18V$)
High Slew Rate: 13 V/μs
Wide Power-Bandwidth: 200 kHz typ.
Very Low Input Noise: 4 nV/√Hz typ.

APPLICATIONS

High Quality Audio Amplification
Telephone Channel Amplifiers
Servo Control Systems
Low-Level Signal Detection
Active Filter Design

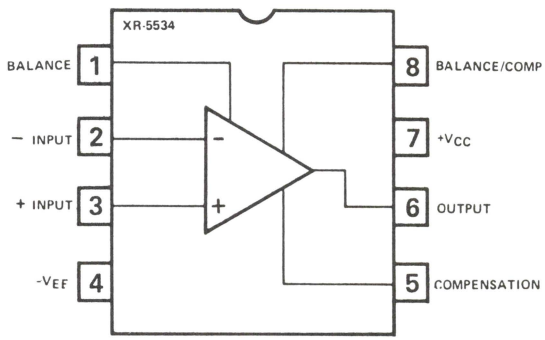
ABSOLUTE MAXIMUM RATINGS

Power Supply	±22 V
Input Common-Mode Voltage	$+V_{CC}$ to $-V_{EE}$
Differential Input Voltage (Note 1)	±0.5 V
Power Dissipation (Package Limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate Above +24°C	2.5 mW/°C
Short Circuit Duration (Note 2)	Indefinite
Storage Temperature	−60°C to +150°C

Note 1: Diodes protect the inputs against over-voltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6V. Maximum current should be limited to ± 10 mA.

Note 2: Output may be shorted to ground at $V_S = \pm 15V$, $T_A = 25°C$. Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
5534AM	Ceramic	−55°C to +125°C
5534M	Ceramic	−55°C to +125°C
5534ACN	Ceramic	0°C to +70°C
5534CN	Ceramic	0°C to +70°C
5534ACP	Plastic	0°C to +70°C
5534CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-5534 and XR-5534A are monolithic operational amplifiers featuring low noise and a very large gain bandwidth product. The devices offer low output resistance and can drive 10 Vrms into 600Ω. Input noise is 100% tested on the XR-5534A, and is typically only 4 nV/√Hz. The small signal bandwidth is 10 MHz and slew rate exceeds 13 V/μS.

Reverse parallel diodes provide input protection; maximum differential input voltage is 0.7 V. Balance pins are provided to zero offset voltage. The device is internally compensated for gains ≥3 and provides external compensation pins for unity gain applications. Supply voltage may range from ±3V to ±20V.

Section 5—Industrial Circuits

Monolithic Timing Circuit

GENERAL DESCRIPTION

The XR-320 monolithic timing circuit is designed for use in instrumentation and digital communications equipment, and for a wide variety of industrial control and special testing applications. In many cases, this circuit provides a monolithic replacement for mechanical or electromechanical timing devices.

The XR-320 timing circuit generates precise timing pulses (or time delays) whose repetition rate (or length) is determined by an external timing resistor, R, and timing capacitor, C. The timing period is exactly equal to 2RC and can be continuously varied from 1 μsec to 1 hour. The circuits can be operated in a monostable or free-running (self-triggering) mode. They can be used for sequential timing and sweep generation, and also for pulse-position and pulse-width modulation.

The XR-320 integrated circuit is comprised of a stable internal bias reference, a precision current source, a voltage comparator, a flip-flop, a timing switch, and a pair of output logic drivers. The high current output at pin 12 can sink or source up to 100 milliamps of current.

FEATURES

Wide Timing Range: 1 μsec to 1 hour
High Accuracy: 1%
Excellent Temperature Stability: 100 ppm/°C
Wide Supply Voltage Range: 4.5V to 18V
Triggering with Positive or Negative-Going Pulses
Programmable
  Resistor Programming: 3 decades
  Capacitor Program: 9 decades
Logic Compatible Outputs
High Current Drive Capability: 100 mA

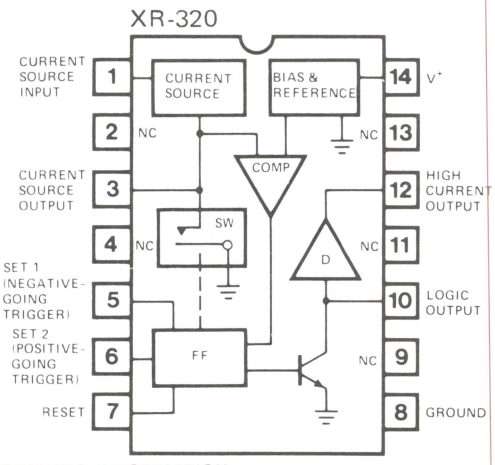
APPLICATIONS

Precision Timing
Time-Delay Generation
Sequential Timing
Pulse Generation/Shaping
Pulse-Position Modulation
Pulse-Width Modulation
Sweep Generation

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts
Internal Power Dissipation	750 mW
Plastic Package:	625 mW
Derate above T_A = +25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-320P	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-320 is an extremely versatile monolithic timer capable of delays ranging from 1 μsec to 1 hour. It works with both positive and negative triggering, and features both normally high and normally low outputs. An on board current source, programmable by an external resistor, changes the timing capacitor. This produces a true ramp function and allows accurate timing intervals equal to 2 RC.

Positive going triggering is applied to Pin 6; negative triggering is applied to Pin 5. After a trigger pulse is applied, the open collector output (Pin 10) will go high and the high current output (Pin 12) switches into the current sink mode. At timeout, the open collector pulls low, and can sink 10 mA; the high current output goes high and can source 100 mA. Utilizing the high current output requires a pull-up resistor from Pin 10 to $+V_{CC}$. The resistor must limit current to no more than 10 mA; 1 mA is sufficient. Timing is interrupted and the device is reset when Pin 7 is grounded. Astable operation is attained by tying the negative going (falling) trigger (Pin 5) to the timing capacitor (Pin 3). In this configuration, the device will automatically retrigger itself upon completion of the timing interval.

Timing Circuit

GENERAL DESCRIPTION

The XR-555 monolithic timing circuit is a highly stable controller capable of producing accurate timing pulses. It is a direct, pin-for-pin replacement for the SE/NE 555 timer. The circuit contains independent control terminals for triggering or resetting if desired.

In the monostable mode of operation, the time delay is controlled by one external resistor and one capacitor. For astable operation as an oscillator, the free-running frequency and the duty cycle are accurately controlled with two external resistors and one capacitor (as shown in Figure 2).

The XR-555 may be triggered or reset on falling waveforms. Its output can source or sink up to 200 mA or drive TTL circuits.

FEATURES

Direct Replacement for SE/NE 555
Timing from Microseconds Thru Hours
Operates in Both Monostable and Astable Modes
High Current Drive Capability (200 mA)
TTL and DTL Compatible Outputs
Adjustable Duty Cycle
Temperature Stability of 0.005%/°C

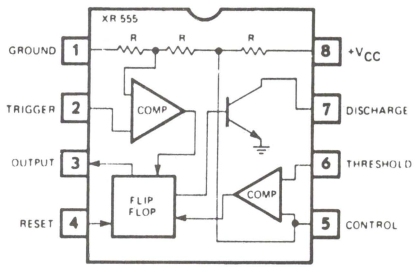
APPLICATIONS

Precision Timing
Pulse Generation
Sequential Timing
Pulse Shaping
Clock Generation
Missing Pulse Detection
Pulse-Width Modulation
Frequency Division
Pulse-Position Modulation
Appliance Timing

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate above +25°C	2.5 mW/°C
Storage Temperature	−65°C to +125°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-555M	Ceramic	−55°C to +125°C
XR-555CN	Ceramic	0°C to +70°C
XR-555CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-555 is an industry standard timing circuit capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage, which may range from 4.5 V to 18 V. The output stage can source or sink 200 mA.

In the monostable (one shot) mode, timing is determined by one resistor and capacitor. Astable operations (oscillation) requires an additional resistor, which controls duty cycle. An internal resistive divider provides a reference voltage of 2/3 V_{CC}, which provides a timing interval of 1.1 RC. As the reference is related to V_{CC}, the interval is independent of supply voltage; however, for maximum accuracy, the user should ensure V_{CC} does not vary during timing.

The output of the XR-555 is high during the timing interval, and pulls low at timeout. It is triggered and reset on falling waveforms. The control voltage input (Pin 5) may serve as a pulse width modulation point.

For applications requiring dual matched 555-type timers, see the XR-556 and XR-2556. For low voltage and/or low power drain applications, consider the XR-L555 and XR-L556 devices.

Micropower Timing Circuit

GENERAL DESCRIPTION

The XR-L555 is a stable micropower controller capable of producing accurate timing pulses. It is a direct replacement for the popular 555-timer for applications requiring very low power dissipation. The XR-L555 has approximately 1/15th the power dissipation of the standard 555-timer and can operate down to 2.7 volts without sacrificing such key features as timing accuracy and frequency stability. At 5-volt operation, typical power dissipation of the XR-L555 is 900 microwatts.

The circuit contains independent control terminals for triggering or resetting if desired. In the monostable mode of operation, the time delay is controlled by one external resistor and one capacitor. For astable operation as an oscillator the free-running frequency and the duty cycle are accurately controlled with two external resistors and one capacitor as shown in Figure 2. The XR-L555 is triggered or reset on falling waveforms. Its output can source up to 100 mA or drive TTL circuits.

Because of its temperature stability and low-voltage (2.7V) operation capability, the XR-L555 is ideally suited as a micropower clock oscillator or VCO for low-power CMOS systems. It can operate up to 1500 hours with only two 300 mA-Hr batteries.

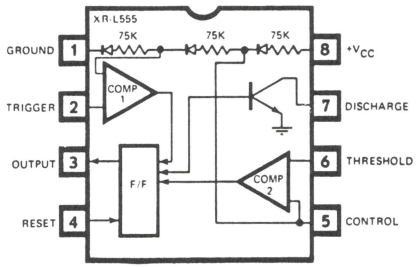
FEATURES

Pin Compatible with Standard 555 Timer
Less than 1 mW Power Dissipation (V+ = 5V)
Timing from Microseconds to Minutes
Over 1000-Hour Operation with 2 Batteries
Low Voltage Operation (V+ = 2.7V)
Operates in Both Monostable and Astable Modes
CMOS TTL and DTL Compatible Outputs

APPLICATIONS

Battery Operated Timing
Micropower Clock Generator
Pulse Shaping and Detection
Micropower PLL Design
Power-On Reset Controller
Micropower Oscillator
Sequential Timing
Pulse Width Modulation
Appliance Timing
Remote-Control Sequencer

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate above +25°C	2.5 mW/°C
Storage Temperature	−65°C to +125°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-L555M	Ceramic	−55°C to +125°C
XR-L555CN	Ceramic	0°C to +70°C
XR-L555CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-L555 is a micropower timing circuit similar to the industry standard 555-type timer. It is capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage which may range from 2.7 V to 15 V. The output stage can source 50 mA.

In the monostable (one shot) mode, timing is determined by one resistor and capacitor. Astable operation (oscillation) requires an additional resistor, which controls duty cycle. An internal resistive divider provides a reference voltage of 2/3 V_{CC}, the interval is independent of supply voltage; however, for maximum accuracy, the user should ensure V_{CC} does not vary during timing.

The output of the XR-L555 is high during the timing interval. It is triggered and reset on falling waveforms. The control voltage input (Pin 5) may serve as a pulse width modulation point.

For applications requiring dual L555-type timers, see the XR-L556.

Dual Timer

GENERAL DESCRIPTION

The XR-556 dual timing circuit contains two independent 555-type timers on a single monolithic chip. It is a direct, pin-for-pin replacement for the SE/NE 556 dual timer. Each timer section is a highly stable controller capable of producing accurate time delays or oscillations. Independent output and control terminals are provided for each section as shown in the functional block diagram.

In the monostable mode of operation, the time delay for each section is precisely controlled by one external resistor and one capacitor. For astable operation as an oscillator, the free-running frequency and the duty cycle of each section are accurately controlled with two external resistors and one capacitor.

The XR-556 may be triggered or reset on falling waveforms. Each output can source or sink up to 150 mA or drive TTL circuits. The matching and temperature tracking characteristics between each timer section of the XR-556 are superior to those available from two separate timer packages.

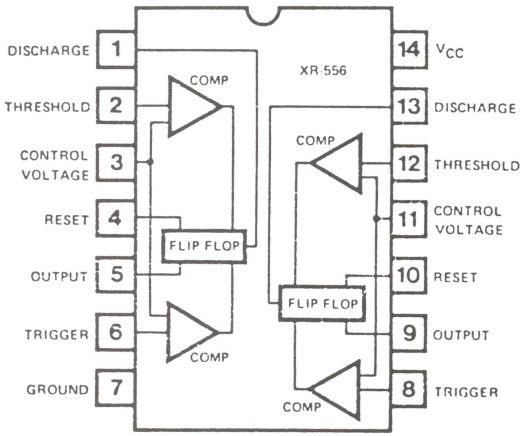
FEATURES

Direct Replacement for SE/NE 556
Replaces Two 555-Type Timers
TTL Compatible Pinouts
Timing from Microseconds Thru Hours
Excellent Matching Between Timer Sections
Operates in Both Monostable and Astable Modes
High Current Drive Capability (150 mA each output)
TTL and DTL Compatible Outputs
Adjustable Duty Cycle
Temperature Stability of 0.005%/°C

APPLICATIONS

Precision Timing
Pulse Generation
Sequential Timing
Pulse Shaping
Time Delay Generation
Clock Pattern Generation
Missing Pulse Detection
Pulse-Width Modulation
Frequency Division
Clock Synchronization
Pulse-Position Modulation
Appliance Timing

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply	18V
Power Dissipation	
Ceramic Dual-In-Line	750 mW
Derate above T_A = 25°C	6 mW/°C
Plastic Dual-In-Line	625 mW
Derate above T_A = 25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-556M	Ceramic	−55°C to +125°C
XR-556CN	Ceramic	0°C to +70°C
XR-556CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-556 is an industry standard dual timing circuit capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage, which may range from, 4.5 V to 18 V. The output stage can source or sink 150 mA. Each timer section is fully independent and similar to 555-type devices.

Micropower Dual Timer

GENERAL DESCRIPTION

The XR-L556 dual timer contains two independent micropower timer sections on a monolithic chip. It is a direct replacement for the conventional 556-type dual timers, for applications requiring very low power dissipation. Each section of the XR-L556 dual timer is equivalent to Exar's XR-L555 micropower timer. The circuit dissipates only 1/15th of the stand-by power of conventional dual timers and can operate down to 2.5 volts without sacrificing such key features as timing accuracy and stability. At 5 volt operation, typical power dissipation of the dual-timer circuit is less than 2 mW; and it can operate in excess of 500 hours with only two 300 mA-Hr NiCd batteries.

The two timer sections of the circuit have separate controls and outputs, but share common supply and ground terminals. Each output can source up to 100 mA of output current or drive TTL circuits.

FEATURES

Replaces two XR-L555 Micropower Timers
Pin Compatible with Standard 556-Type Dual Timer
Less than 1 mW Power Dissipation per Section (V_{CC} = 5V)
Timing from Microseconds to Minutes
Over 500-Hour Operation with 2 NiCd Batteries Low Voltage Operation (V_{CC} = 2.5V)
Operates in Both Monostable and Astable Modes
CMOS TTL and DTL Compatible Outputs
Introduces No Switching Transients

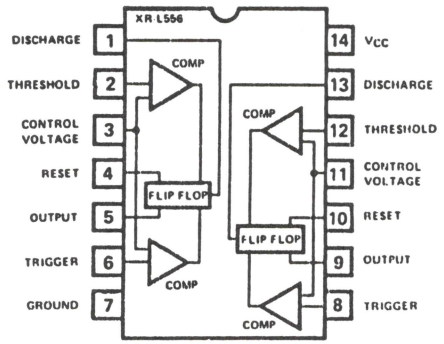
APPLICATIONS

Battery Operated Timing
Micropower Clock Generator
Pulse Shaping and Detection
Micropower PLL Design
Power-On Reset Controller
Micropower Oscillator
Sequential Timing
Pulse-Width Modulation
Appliance Timing
Remote-Control Sequencer

ABSOLUTE MAXIMUM RATINGS

Power Supply	18V
Power Dissipation	
Ceramic Dual-In-Line	750 mW
Derate above T_A = 25°C	6 mW/°C
Plastic Dual-In-Line	625 mW
Derate above T_A = 25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-L556 M	Ceramic	−55°C to +125°C
XR-L556 CN	Ceramic	0°C to +70°C
XR-L556 CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-L556 is a micropower version of the industry standard XR-556 timing circuit, capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage, which may range from 2.5 V to 15 V. The output stage can source 100 mA. Each timer section is fully independent and similar to the XR-L555.

In the monostable (one shot) mode, timing is determined by one resistor and capacitor. Astable operation (oscillation) requires an additional resistor, which controls duty cycle. An internal resistive divider provides a reference voltage of 2/3 V_{CC}, which produces a timing interval of 1.1 RC. As the reference is related to V_{CC}, the interval is independent of supply voltage; however, for maximum accuracy, the user should ensure V_{CC} does not vary during timing.

The output of the XR-L556 is high during the timing interval. It is triggered and reset on falling waveforms. The control voltage inputs (Pins 3 and 11) may serve as pulse width modulation points.

Quad Timing Circuits

GENERAL DESCRIPTION

The XR-558 and the XR-559 quad timing circuits contain four independent timer sections on a single monolithic chip. Each of the timer sections on the chip are entirely independent, and each one can produce a time delay from microseconds to minutes, as set by an external R-C network. Each timer has its separate trigger terminal, but all four timers in the IC package share a common reset control.

Both the XR-558 and the XR-559 quad timer circuits are "edge-triggered" devices, so that each timer section can be cascaded, or connected in tandem, with other timer sections, without requiring coupling capacitors.

The XR-558 is designed with open-collector outputs; each output can sink up to 100 mA. The XR-559 is designed with emitter-follower outputs. Each output can source up to 100 mA of load current. The outputs are normally at "low" state, and go to "high" state during the timing interval.

FEATURES

Four Independent Timer Sections
High Current Output Capability
  XR-558: 100 mA sinking capability/output
  XR-559: 100 mA sourcing capability/output
Edge Triggered Controls
Output Stage Independent of Trigger Condition
Wide Supply Range: 4.5 V to 16 V

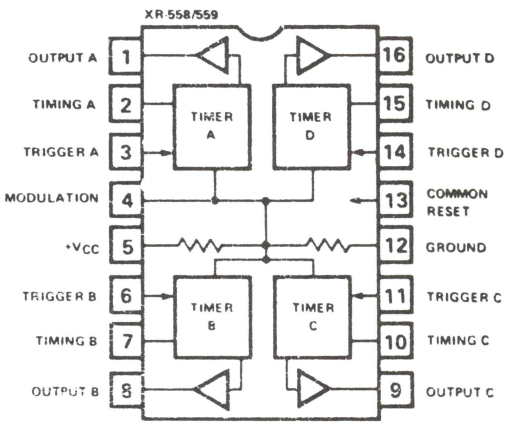
APPLICATIONS

Precision Timing
Pulse Shaping
Clock Synchronization
Appliance Timing

ABSOLUTE MAXIMUM RATINGS

Power Supply	18V
Power Dissipation	
Ceramic Dual-In-Line	750 mW
Derate above T_A = 25″	6 mW/°C
Plastic Dual-In-Line	625 mW
Derate above T_A = 25″C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-558M	Ceramic	−55°C to +125°C
XR-558CN	Ceramic	0°C to +70°C
XR-558CP	Plastic	0°C to +70°C
XR-559M	Ceramic	−55°C to +125°C
XR-559CN	Ceramic	0°C to +70°C
XR-559CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-558 and XR-559 are easy to use quad timers capable of operation with supply voltages between 4.5 V and 18 V. Each section has independent timing and triggering, and can operate over intervals ranging from the low microseconds up through several minutes. The devices are triggered on falling waveforms and are immune to long trigger pulses. When the reset pin (Pin 13) is held below 0.8 V, all four outputs are set low and all triggers are disabled. Timing period accuracy is typically better than 1%, independent of V_{CC}, and drift is better than 150 ppm/°C and 0.5%/V. The timing period, in seconds, equals R times C.

The XR-558 features open collector outputs, capable of sinking 100 mA, that are driven low during the timing interval. The XR-559 has emitter followers, active upon timeout, capable of sourcing 100 mA. The XR-558 sinks load current from $+V_{CC}$, the XR-559 sources load current to ground.

Dual Timing Circuit

GENERAL DESCRIPTION

The XR-2556 dual timing circuit contains two independent 555-type timers on a single monolithic chip. Each timer section is a highly stable controller capable of producing accurate time delays or oscillations. Independent output and control terminals are provided for each section as shown in the functional block diagram.

In the monostable mode of operation, the time delay for each section is precisely controlled by one external resistor and one capacitor. For astable operation as an oscillator, the free-running frequency and the duty cycle of each section are accurately controlled with two external resistors and one capacitor.

The XR-2556 may be triggered or reset on falling waveforms. Each output can source or sink up to 200 mA or drive TTL circuits. The matching and temperature tracking characteristics between each timer section of the XR-2556 are superior to those available from two separate timer packages.

FEATURES

Replaces Two 555-Type Timers
TTL Compatible Pinouts (Gnd—Pin 7, V_{CC}—Pin 14)
Timing from Microseconds Thru Hours
Excellent Matching Between Timer Sections
Operates in Both Monostable and Astable Modes
High Current Drive Capability (200 mA each output)
TTL and DTL Compatible Outputs
Adjustable Duty Cycle
Temperature Stability of 0.005%/°C
Normally ON and Normally OFF Outputs

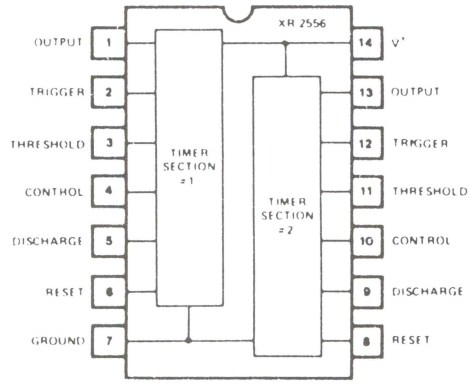
APPLICATIONS

Precision Timing
Pulse Generation
Sequential Timing
Pulse Shaping
Time Delay Generation
Clock Pattern Generation
Missing Pulse Detection
Pulse-Width Modulation
Frequency Division
Clock Synchronization
Pulse-Position Modulation

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts
Power Dissipation	
Ceramic Dual-In-Line	750 mW
Derate above T_A = 25°C	5 mW/°C
Plastic Dual-In-Line	625 mW
Derate above T_A = 25°C	5 mW/°C
Storage Temperate Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2556M	Ceramic	−55°C to +125°C
XR-2556CN	Ceramic	0°C to +70°C
XR-2556CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2556 is a high output dual timing circuit similar to the popular 555-type timer, capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage, which may range from 4.5 V to 18 V. The output stage can source or sink 200 mA. Each timing section is fully independent.

In the monostable (one shot) mode, timing is determined by one resistor and capacitor. Astable operation (oscillation) requires an additional resistor, which controls duty cycle. An internal resistive divider provides a reference voltage of 2/3 V_{CC}, which produces a timing interval of 1.1 RC. As the reference is related to V_{CC}, the interval is independent of supply voltage; however, for maximum accuracy, the user should ensure V_{CC} does not vary during timing.

The output of the XR-2556 is high during the timing interval and pulls low at timeout. It is triggered and reset on falling waveforms. The control voltage inputs (Pins 4 and 10) may serve as pulse width modulation points. Matching between sections is typically better than 0.2% initially with temperature drift tracking to ±10 ppm/°C.

For low voltage and/or low power drain applications consider the XR-L556.

Programmable Timer/Counter

GENERAL DESCRIPTION

The XR-2240 Programmable Timer/Counter is a monolithic controller capable of producing ultra-long time delays without sacrificing accuracy. In most applications, it provides a direct replacement for mechanical or electromechanical timing devices and generates programmable time delays from micro-seconds up to five days. Two timing circuits can be cascaded to generate time delays up to three years.

As shown in Figure 1, the circuit is comprised of an internal time-base oscillator, a programmable 8-bit counter and a control flip-flop. The time delay is set by an external R-C network and can be programmed to any value from 1 RC to 255 RC.

In astable operation, the circuit can generate 256 separate frequencies or pulse-patterns from a single RC setting and can be syncronized with external clock signals. Both the control inputs and the outputs are compatible with TTL and DTL logic levels.

FEATURES

Timing from micro-seconds to days
Programmable delays: 1RC to 255 RC
Wide supply range; 4V to 15V
TTL and DTL compatible outputs
High accuracy: 0.5%
External Sync and Modulation Capability
Excellent Supply Rejection: 0.2%/V

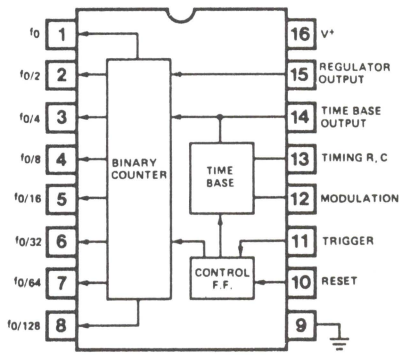
APPLICATIONS

Precision Timing	Frequency Synthesis
Long Delay Generation	Pulse Counting/Summing
Sequential Timing	A/D Conversion
Binary Pattern Generation	Digital Sample and Hold

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	18V
Power Dissipation	
Ceramic Package	750 mW
Derate above +25°C	6 mw/°C
Plastic Package	625 mW
Derate above +25°C	5 mW/°C
Operating Temperature	
XR-2240M	−55°C to +125°C
XR-2240C	0°C to +70°C
Storage Temperature	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2240M	Ceramic	−55°C to +125°C
XR-2240N	Ceramic	0°C to +70°C
XR-2240CN	Ceramic	0°C to +70°C
XR-2240P	Plastic	0°C to +70°C
XR-2240CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2240 is a combination timer/counter capable of generating accurate timing intervals ranging from microseconds through several days. The time base works as an astable multivibrator with a period equal to RC. The eight bit counter can divide the time base output by any integer value from 1 to 255. The wide supply voltage range of 4.5 to 15 V, TTL and DTL logic compatibility, and 0.5% accuracy allow wide applicability. The counter may operate independently of the time base. Counter outputs are open collector and may be wire-OR connected.

The circuit is triggered or reset with positive going pulses. By connecting the reset pin (Pin 10) to one of the counter outputs, the time base will halt at timeout. If none of the outputs are connected to the reset, the circuit will continue to operate in the astable mode. Activating the trigger terminal (Pin 11) while the timebase is stopped will set all counter outputs to the low state and start the timebase.

Long Range Timer

GENERAL DESCRIPTION

The XR-2242 is a monolithic timer/controller capable of producing ultra-long time delays from milliseconds to days. Two timing circuits can be cascaded to generate time delays or timing intervals up to one year. The circuit is comprised of an internal time-base oscillator, an 8 bit binary counter and a control flip-flop. For a given external R-C network connected to the timing terminal, the circuit produces an output timing pulse of 128 RC. If two circuits are cascaded, a total time delay of $(128)^2$ or 16,384 RC is obtained.

Three output pins are provided on the device: the time base (RC) on Pin 8, 2 RC on Pin 2, and the counter output (128 RC) on Pin 3.

FEATURES

Timing from micro-seconds to days
Wide supply range: 4.5V to 15V
TTL and DTL compatible outputs
High accuracy: 0.5%
Excellent Supply Rejection: 0.2%/V
Monostable and Astable Operation

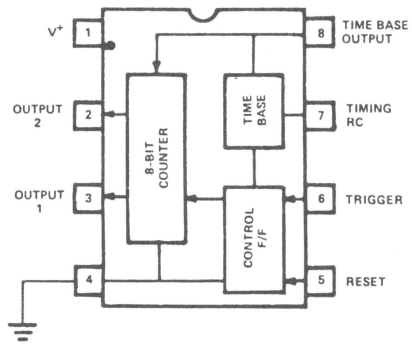
APPLICATIONS

Long Delay Generation
Sequential Timing
Precision Timing
Ultra-Low Frequency Oscillator

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate above +25°C	2.5 mW/°C
Temperature Range	
Operating	
XR-2242M	−55°C to +125°C
XR-2242C	0°C to +70°C
Storage	−65° to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2242M	Ceramic	−55°C to +125°C
XR-2242CN	Ceramic	0°C to +70°C
XR-2242CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The timing cycle for the XR-2242 is initiated by applying a positive-going trigger pulse to Pin 6. The trigger input actuates the time-base oscillator, enables the counter section, and sets the output to "low" state. The time-base oscillator generates timing pulses with its period, T, equal to 1 RC. These clock pulses are counted by the binary counter section. The timing cycle is completed when a positive-going reset pulse is applied to Pin 5.

In monostable timer applications the output terminal (Pin 3) is connected back to the reset terminal. In this manner, after 128 clock pulses are applied to the circuit, this output goes to "high" state and resets the circuit thus completing the timing cycle. Thus, subsequent to triggering, the output at Pin 3 will produce a total timing pulse of 128 RC before the circuit resets itself to complete the timing cycle. During the timing interval, the secondary output at Pin 2 produces a square-wave output with the period of 2 RC.

If the output at Pin 3 is not connected back to the reset terminal, the circuit continues to operate in an astable mode, subsequent to a trigger input.

Micropower Long Range Timer

GENERAL DESCRIPTION

The XR-2243 is a monolithic Timer/Controller capable of producing ultra-long time delays from micro-seconds to days. Two timing circuits can be cascaded to generate time delays or timing intervals up to one year. The circuit is comprised of an internal time-base oscillator, an 11-bit binary counter and a control flop-flop. For a given external R-C network connected to the timing terminal, the circuit produces an output timing pulse of 1024 RC. If the two circuits are cascaded, a total time delay of $(1024)^2$ or 1,048,576 RC is obtained.

The XR-2243 long range timer was designed for low power operation. Its supply current requires less than 100 μA in standby or reset mode. Normal operation requires less than 1mA.

The timing cycle is initiated by applying a positive going pulse to the trigger input, Pin 6. The time-base oscillator generates timing pulses with its period, T, equal to 1 RC. These clock pulses are counted by the binary counter section. The timing cycle is completed when a positive-going reset pulse is applied to Pin 5.

In monostable timer applications, the output terminal (Pin 3) is connected to the reset terminal, Pin 5. In this manner, after 1024 clock pulses are counted, this output goes to "high" state and resets the circuit, thus completing the timing cycle. Therefore, after triggering, the output at Pin 3 will produce a total timing pulse of 1024 RC before the circuit resets itself to complete the timing cycle. During the timing interval, the secondary output at Pin 2 produces a square-wave output with the period of 2 RC.

If the output at Pin 3 is not connected back to the reset terminal, the circuit continues to operate in an astable mode, subsequent to a trigger input.

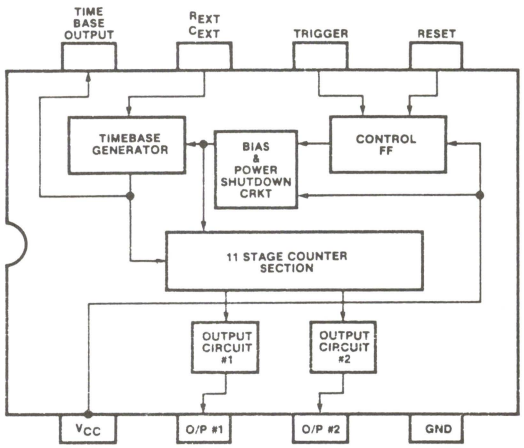
APPLICATIONS

Long Delay Generation
Sequential Timing
Precision Timing
Ultra-Low Frequency Oscillator
Battery Powered Applications

FEATURES

High Output Current Sink Capability
Timing from Micro-seconds to Days
Wide Supply Range: 2.2V to 15V
TTL and DTL Compatible Outputs

FUNCTIONAL BLOCK DIAGRAM



High Accuracy: 0.5%
Excellent Supply Rejection
Monostable and Astable Operation
Micro Power Consumption-Standby Operation
Low Power Consumption-Normal Operation

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 Volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic package	300 mW
Derate above +25°C	2.5 mW/°C
Temperature Range	
Operating	
XR-2243C	0°C to +70°C
Storage	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2243CN	Ceramic	0°C to +70°C
XR-2243CP	Plastic	0°C to +70°C

PRINCIPLES OF OPERATION

The ultra-long time delay micropower timer, in simplest block diagram terms, consists of a timing section followed by a counter section and a control flip-flop.

The main functional portion of the circuit is the time base section. It is a relaxation oscillator whose period

Section 5—Industrial Circuits

Pulse-Width Modulating Regulator

GENERAL DESCRIPTION

The XR-494 is a monolithic pulse width modulating regulator designed to contain all the blocks necessary for a switching regulator. Included in a 16 pin dual in-line package is a voltage reference, oscillator, control logic, error amplifiers, and dual uncommitted outputs. This device can be used for switching regulators of either polarity, polarity converters, transformer coupled DC to DC converters, transformerless voltage doublers, and many other power control applications. The XR-494M is fully specified for operation over the full military temperature range from −55°C to +125°C, while the XR-494CN and XR-494CP are designed for commercial applications over 0°C to +70°C.

FEATURES

Complete PWM Power Control Circuitry
Uncommitted Outputs for 200-mA Sink or Source
Output Control Selects Single-Ended or Push-Pull Operation
Internal Circuitry Prohibits Double Pulse at Either Output
Variable Dead Time Provides Control Over Total Range
Internal Regulator Provides a Stable 5-V Reference Supply
Circuit Architecture Provides Easy Synchronization

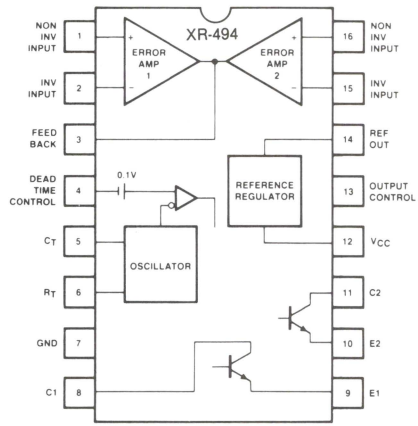
APPLICATIONS

Pulse-Width Modulated Power Control Systems
Switching Regulators

ABSOLUTE MAXIMUM RATINGS, T_A = 25°C

Amplifier Input Voltages	V_{CC} + 0.3 Volts
Output Current	250 mA
Supply Voltage	41 Volts
Collector Output Voltage	41 Volts
Power Dissipation	
Total, at or below 25°C	1000 mW
Ceramic Package	
Derate above +28°C	8.2 mW/°C
Plastic Package	
Derate above +41°C	9.2 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-494M	Ceramic	−55°C to +125°C
XR-494CN	Ceramic	0°C to +70°C
XR-494CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

All functions required to construct a pulse-width modulating regulator are incorporated on a single monolithic chip in the XR-494. The device is primarily designed for power supply control and contains a on-chip five volt regulator, two error amplifiers, an adjustable oscillator, dead-time control comparator, a pulse-steering flip-flop, and output control circuits. Either common emitter or emitter follower output capability is provided by the uncommitted output transistors. Single ended or push-pull output operation may be selected through the output control function. The XR-494 architecture prohibits the possibility of either output being pulsed twice during push-pull operation. The internal amplifiers's circuitry allows for a common-mode input voltage range of −0.3 volt to V_{CC} −2 volts. The dead time control comparator provides approximately 5% dead time unless the dead time control is externally driven. The on-chip oscillator may be used to drive the common XR-494 circuitry and provide a sawtooth input for associated control circuitry in synchronous multiple-rail power supplies, or may be bypassed by terminating R_T (Pin 6) to the reference output and providing a sawtooth input to C_T (Pin 5).

Pulse-Width Modulating Regulator

GENERAL DESCRIPTION

The XR-495 is a monolithic pulse width modulating regulator designed to contain all blocks necessary for a switching regulator. Included in the 16 pin dual in-line packages is a voltage reference, oscillator, control logic, error amplifiers, and dual uncommitted outputs. This device can be used for switching regulators of either polarity, polarity converters, transformer coupled DC to DC converters, transformerless voltage doublers, and many other power control applications. A 39V zener diode allows operation with supply voltages exceeding 40V. The XR-495M is fully specified for operation over the full military temperature range from −55°C to +125°C, while the XR-495CN and XR-495CP are designed for commercial applications over 0°C to +70°C.

FEATURES

Complete PWM Power Control Circuitry
Uncommitted Outputs for 200-mA Sink or Source
Output Control Selects Single-Ended or Push-Pull Operation
Internal Circuitry Prohibits Double Pulse at Either Output
Variable Dead Time Provides Control Over Total Range
Internal Regulator Provides a Stable 5-V Reference Supply
Circuit Architecture Provides Easy Synchronization
On-Chip 39-V Zener
External Control of Output Steering

APPLICATIONS

Pulse-Width Modulated Power Control Systems
Switching Regulators

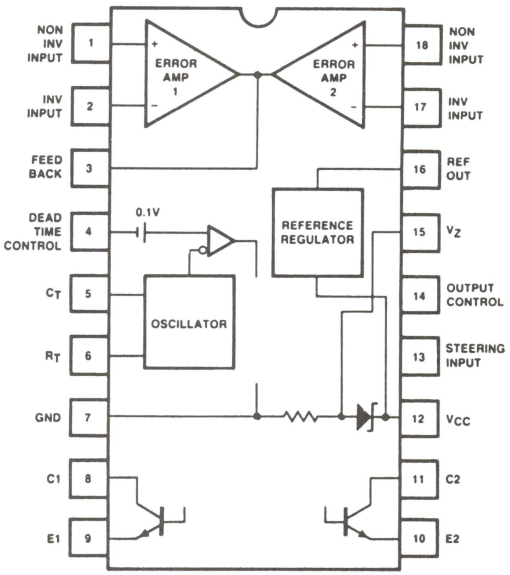
ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-495M	Ceramic	−55°C to +125°C
XR-495CN	Ceramic	0°C to +70°C
XR-495CP	Plastic	0°C to +70°C

ABSOLUTE MAXIMUM RATINGS, T_A = 25°C

Amplifier Input Voltages	V_{CC} + 0.3 Volts
Output Current	250 mA
Supply Voltage	41 Volts
Collector Output Voltage	41 Volts
Power Dissipation	
Total, at or below 25°C	1000 mW
Ceramic Package	
Derate above +28°C	8.2 mW/°C
Plastic Package	
Derate above +41°C	9.2 mW/°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

All functions required to construct a pulse-width modulating regulator are incorporated on a single monolithic chip in the XR-495. The device is primarily designed for power supply control and contains a on-chip five volt regulator, two error amplifiers, an adjustable oscillator, dead-time control comparator, a pulse-steering flip-flop, and output control circuits. Either common emitter or emitter follower output capability is provided by the uncommitted output transistors. Single ended or push-pull output operation may be selected through the output control function. The XR-495 architecture prohibits the possibility of either output being pulsed twice during push-pull operation. The internal amplifier's circuitry allows for a common-mode input voltage range of −0.3 volt to V_{CC} −2 volts. The dead time control comparator provides approximately 5% dead time unless the dead time control is externally driven. The on-chip oscillator may be used to drive the common XR-495 circuitry and provide a sawtooth input for associated control circuitry in synchronous multiple-rail power supplies, or may be bypassed by terminating R_T (Pin 6) to the reference output and providing a sawtooth input to C_T (Pin 5).

The XR-495 also contains an on-chip 39 volt zener diode for high voltage applications where V_{CC} is greater than 40 volts, and an output steering control that overrides the internal control of the pulse steering flip-flop.

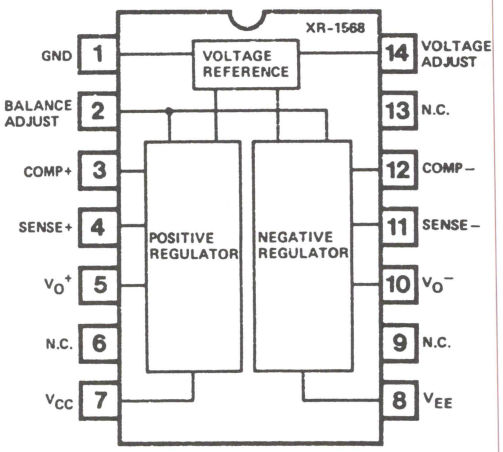
Dual-Polarity Tracking Voltage Regulator

GENERAL DESCRIPTION

The XR-1468/1568 is a dual polarity tracking voltage regulator, internally trimmed for symmetrical positive and negative 15V outputs. Current output capability is 100 mA, and may be increased by adding external pass transistors. The device is intended for local "on-card" regulation, which eliminates the distribution problems associated with single point regulation.

The XR-1468CN and XR-1568N are guaranteed over the 0°C to 70°C commercial temperature range. The XR-1568M is rated over the full military temperature range of −55°C to +125°C.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Internally Set for ±15V Outputs
±100 mA Peak Output Current
Output Voltages Balanced Within 1% (XR-1568)
0.06% Line and Load Regulation
Low Stand-By Current
Output Externally Adjustable from ±8 to ±20 Volts
Externally Adjustable Current Limiting
Remote Sensing

ORDERING INFORMATION

Part Number	Temperature	Output Offset	Package
XR-1568M	−55°C to +125°C	±150 mV max	Ceramic
XR-1568N	0°C to +70°C	±150 mV max	Ceramic
XR-1468CN	0°C to +70°C	±300 mV max	Ceramic

APPLICATIONS

Main Regulation in Small Instruments
On-Card Regulation in Analog and Digital Systems
Point-of-Load Precision Regulation

ABSOLUTE MAXIMUM RATINGS

Power Supply	±30 Volts
Minimum Short-Circuit Resistance	4.0 Ohms
Load Current, Peak	±100 mA
Power Dissipation	
Ceramic (N) Package	1.0 Watt
Derate Above +25°C	6.7 mW/°C
Operating Temperature	
XR-1568M	−55°C to +125°C
XR-1568/XR-1468C	0°C to +70°C
Storage Temperature	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-1468/1568 is a dual polarity tracking voltage regulator combining two separate regulators with a common reference element in a single monolithic circuit, thus providing a very close balance between the positive and negative output voltages. Outputs are internally set to ±15 Volts but can be externally adjusted between ±8.0 to ±20 Volts with a single control. The circuit features ±100 mA output current, with externally adjustable current limiting, and provision for remote voltage sensing.

Pulse-Width Modulating Regulator

GENERAL DESCRIPTION

The XR-1524 family of monolithic integrated circuits contain all the control circuitry for a regulating power supply inverter or switching regulator. Included in a 16-pin dual-in-line package is the voltage reference, error-amplifier, oscillator, pulse width modulator, pulse steering flip-flop, dual alternating output switches and current limiting and shut-down circuitry. This device can be used for switching regulators of either polarity, transformer coupled DC to DC converters, transformerless voltage doublers and polarity converters, as well as other power control applications. The XR-1524 is specified for operation over the full military temperature range of −55°C to +125°C, while the XR-2524 and XR-3524 are designed for commercial applications of 0°C to +70°C.

FEATURES

Direct Replacement for SG-1524/2524/3524
Complete PWM power control circuitry
Single ended or push-pull outputs
Line and load regulation of 0.2%
1% maximum temperature variation
Total supply current less than 10 mA
Operation beyond 100 kHz

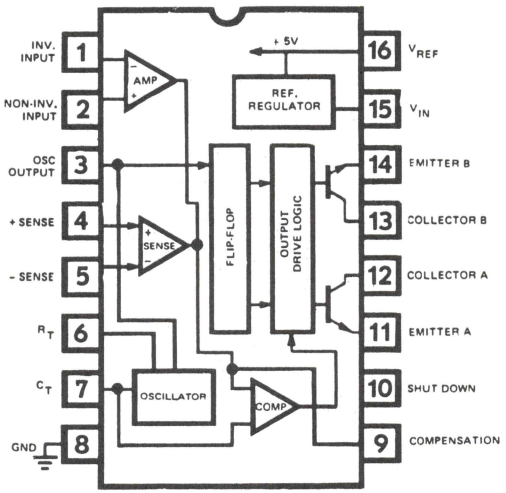
APPLICATIONS

Switching Regulators
Pulse-width Modulated Power Control Systems

ABSOLUTE MAXIMUM RATINGS

Input Voltage	40V
Output Current (each output)	100 mA
Reference Output Current	50 mA
Oscillator Charging Current	5 mA
Power Dissipation	
Ceramic Package	1000 mW
Derate above +25°C	8 mW/°C
Plastic Package	625 mW/°C
Derate above +25°C	5 mW/°C
Operating Temperature Range	
XR-1524	−55°C to +125°C
XR-2524/XR-3524	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1524M	Ceramic	−55°C to +125°C
XR-2524N	Ceramic	0°C to +70°C
XR-2524P	Plastic	0°C to +70°C
XR-3524N	Ceramic	0°C to +70°C
XR-3524P	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-1524/2524/3524 pulse width modulating regulator is a complete monolithic switching regulator. An internal 5V reference, capable of supplying up to 50 mA to external loads, provides an on board operating standard. The oscillator frequency and duty cycle are adjusted by an external RC network. Regulation is controlled by an error amplifier which, combined with the sense amplifier, also allows current limiting and remote shutdown functions. The outputs of the XR-1524/2524/3524 are two identical NPN transistors with both emitters and collectors uncommitted. Each output transistor has antisaturation circuitry for fast response and local current limiting set at 100 mA.

Pulse-Width Modulating Regulators

GENERAL DESCRIPTION

The XR-1525A/1527A is a series of monolithic integrated circuits that contain all of the control circuitry necessary for a pulse-width modulating regulator. Included in the 16-Pin dual-in-line package is a voltage reference, an error amplifier, a pulse-width modulator, an oscillator, under-voltage lockout, soft-start circuitry, and output drivers.

The XR-1525A/2525A/3525A series features NOR logic, giving a LOW output for an OFF state. The XR-1527A/2525A/3527A series features OR logic, giving a HIGH output for an OFF state.

FEATURES

8V to 35V Operation
5.1V Reference Trimmed to ±1%
100 Hz to 500 kHz Oscillator Range
Separate Oscillator Sync Terminal
Adjustable Deadtime Control
Internal Soft-Start
Input Under-voltage Lockout
Latching PWM to Prevent Double Pulsing
Dual Source/Sink Output Drivers
  Capable of Over 200 mA
Power-FET Drive Capability

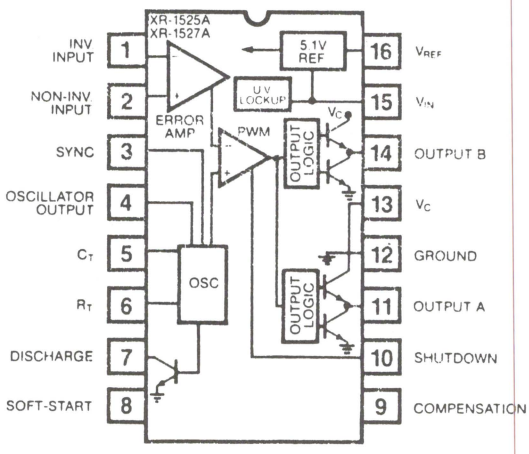
APPLICATIONS

Power Control Systems
Switching Regulators
Industrial Controls

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (+ V_{IN})	+40V
Collector Supply Voltage (V_C)	+40V
Logic Inputs	−0.3V to 5.5V
Analog Inputs	−0.3V to +V_{IN}
Output Current, Source or Sink	500 mA
Reference Output Current	50 mA
Oscillator Charging Current	5 mA
Power Dissipation	
Ceramic Package	1000 mW
Derate above T_A = +25°C	8.0 mW/°C
Plastic Package	625 mW
Derate above T_A = +25°C	5.0 mW/°C
Operating Junction Temperature (T_J)	+150°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1525A/27M	Ceramic	−55°C to +125°C
XR-2525A/27AN	Ceramic	−25°C to +85°C
XR-2525A/27AP	Plastic	−25°C to +85°C
XR-3525A/27CN	Ceramic	0°C to +70°C
XR-3525A/27CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The on-chip 5.1-volt reference is trimmed to ±1% initial accuracy, and the common-mode input range of the error amplifier is extended to include the reference voltage. Deadtime is adjustable with a single external resistor. A sync input to the oscillator allows multiple units to be slaved together, or a single unit to be synchronized to an external clock. A positive-going signal applied to the shutdoown pin provides instantaneous turnoff of the outputs. The under-voltage lockout circuitry keeps the output drivers off, and the soft-start capacitor discharged, for an input voltage below the required value. The latch on the PWM comparator insures the outputs are active only once per oscillator period, thereby eliminating any double pulsing. The latch is reset with each clock pulse.

The output drivers are totem-pole designs capable of sinking and sourcing over 200 mA.

Power Supply Output Supervisory Circuit

GENERAL DESCRIPTION

The XR-1543/2543/3543 are monolithic integrated circuits that contain all the functions necessary to monitor and control the output of a power supply system. Included in the 16-Pin dual-in-line package is a voltage reference, an operational amplifier, voltage comparators, and a high-current SCR trigger circuit. The functions performed by this device include over-voltage sensing, under-voltage sensing and current limiting, with provisions for triggering an external SCR "crowbar."

The internal voltage reference on the XR-1543 is guaranteed for an accuracy of ± 1% to eliminate the need for external potentiometers. The entire circuit may be powered from either the output that is being monitored or from a separate bias voltage.

FEATURES

Over-Voltage Sensing Capability	
Under-Voltage Sensing Capability	
Current Limiting Capability	
Reference Voltage Trimmed	±1%
SCR "Crowbar" Drive	300 mA
Programmable Time Delays	
Open Collector Outputs and Remote Activation Capability	
Total Standby current	Less than 10 mA

APPLICATIONS

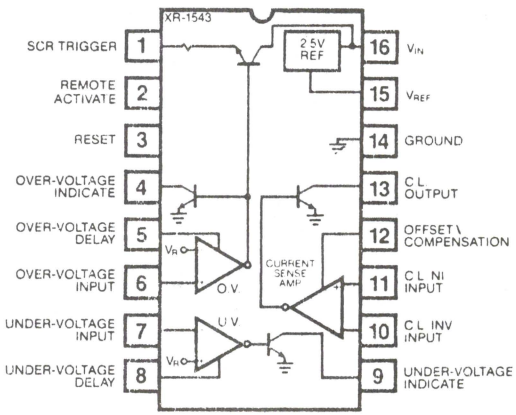
DC/DC Converters
Switch Mode Power Supplies
Power Line Monitors
Linear Power Supplies

ABSOLUTE MAXIMUM RATINGS

Input Supply Voltage, V_{IN}	40V
Sense Inputs	V_{IN}
SCR Trigger Current (Note 1)	300 mA
Indicator Output Voltage	40V
Indicator Output Sink Current	50 mA
Power Dissipation (Ceramic)	1000 mW
Derate Above T_A = +25°C	8 mW/°C
Power Dissipation (Plastic)	625 mW
Derate Above T_A = +25°C	5 mW/°C
Operating Junction Temperature (T_J)	+150°C
Storage Temperature Range	−65°C to +150°C

Note 1: At higher input voltages, a dissipation limiting resistor, R_G, is required.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1543M	Ceramic	−55°C to +125°C
XR-2543N	Ceramic	−25°C to +85°C
XR-3543N	Ceramic	0°C to +70°C
XR-3543P	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

An output supervisory circuit, such as the XR-1543, is used to control and monitor the performance of a power supply. In many systems, it is crucial that the supply voltage is always within some minimum and maximum level, to guarantee proper performance, and to prevent damage to the system. If the supply voltage is out of tolerance, it is often desirable to shut down the system or to have some form of indication to the operator or system controller. As well as protecting the system, the power supply sometimes needs to be protected under short circuit and current overload situations. By providing an SCR "crowbar" on the output of a power supply, it can be shut off under certain fault conditions as well.

The over-voltage sensing circuit (O.V.) can be used to monitor the output of a power supply and provide triggering of an SCR, when the output goes above the prescribed voltage level. The under-voltage sensing circuit (U.V.) can be used to monitor either the output of a power supply or the input line voltage.

Pulse-Width Modulator Control System

GENERAL DESCRIPTION

The XR-2230 is a high-performance monolithic pulse width modulator control system. It contains all the necessary control blocks for designing switch mode power supplies, and other power control systems. Included in the 18-Pin dual-in-line package are two error amplifiers, a sawtooth generator, and the necessary control logic to drive two open-collector power transistors. Also included are protective features, such as adjustable dead-time control, thermal shutdown, soft-start control, and double-pulse protection circuitry.

The device provides two open-collector output transistors which are driven 180° out-of-phase, and are capable of sinking 30 mA. These outputs can be used to implement single-ended or push-pull switching regulation of either polarity in transformerless or transformer-coupled converters.

FEATURES

Thermal Shutdown
Adjustable Dead-time
Dual Open-Collector
  30 mA Output Transistors
Double-Pulse Protection Circuit
Soft-Start Control
High-Speed Remote Shut-Down Input
Two High-Performance Error Amplifiers
  with ±5V Input Common-Mode Range

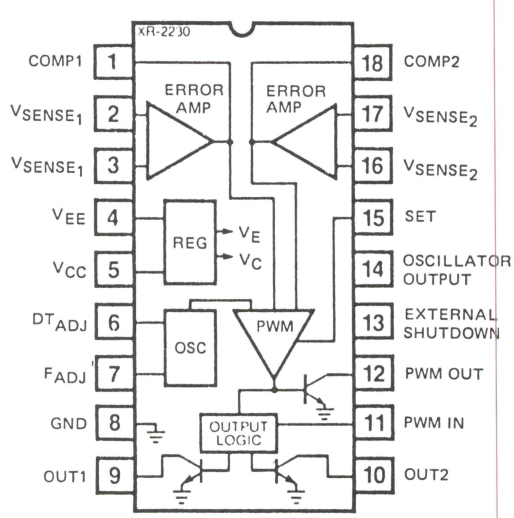
APPLICATIONS

Switching Regulators
Motor-Speed Controllers
Pulse-Width Modulated Control Systems

ABSOLUTE MAXIMUM RATINGS

Positive Supply Voltage	−0.5 to +18V
Negative Supply Voltage	+0.5 to −18V
Input Voltage	−18 to +18V
Output Voltage	−0.5 to +18V
Power Dissipation ($T_A \leq 25°C$)	400 mW
Operating Temperature	−10°C to +85°C
Storage Temperature	−55°C to +125°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2230CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2230 PWM circuit contains two high-performance error amplifiers with wide input common-mode range, and large voltage gains. Typically, one amplifier (Pins 16, 17, 18) is used for current sensing and the other (Pins 1, 2, 3) is used as an error amplifier to sense the output voltage. The XR-2230 requires a split supply between ±8 volts and ±15 volts, however, it can be operated from a single supply with proper external biasing on the ground pin and input pins of the error amplifiers. The output drivers capable of sinking 30 mA at a saturation voltage of about 0.3V can be used in a push-pull configuration, or can be paralleled for a single-ended configuration with a duty cycle between 0% to over 90%.

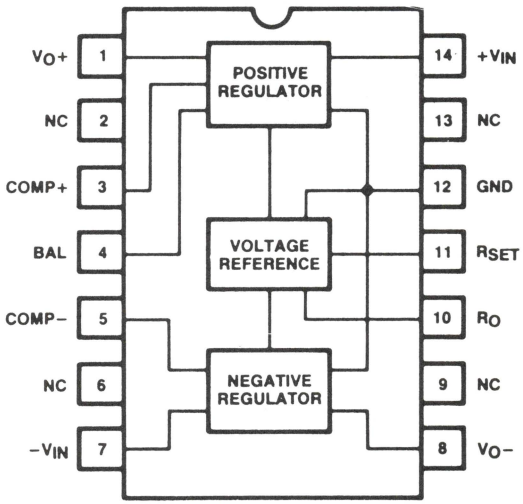
The XR-2230 features a self-protecting thermal-shutdown circuitry which turns off the output drivers when the junction temperature exceeds 130°C. The on-board regulator stabilizes the oscillator frequency to 0.1%/V for reliable performance.

Dual-Tracking Voltage Regulator

GENERAL DESCRIPTION

The XR-4194 is a dual-polarity tracking regulator designed to provide balanced or unbalanced positive and negative output voltages at currents of up to 200 mA. A single resistor can be used to adjust both outputs between the limits of ±50mV and ±42 V. The device is ideal for local on-card regulation, which eliminates the distribution problems associated with single-point regulation. The XR-4194 is available in a 14-pin ceramic dual-in-line package, which has a 900 mW rating.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Direct Replacement for RM/RC 4194
Both Outputs Adjust with Single Resistor
Load Current to ±200 mA with 0.2% Load Regulation
Low External Parts Count
Internal Thermal Shutdown at T_J = 175°C
External Adjustment for ± V_O Unbalancing

APPLICATIONS

On-Card Regulation
Adjustable Regulator

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4194CN	Ceramic DIP	0°C to +70°C
XR-4194M	Ceramic DIP	−55°C to +125°C

ABSOLUTE MAXIMUM RATINGS

Input Voltage ± V to Ground	
XR-4194M	±45 V
XR-4194CN	±35 V
Input/Output Voltage Differential	±45 V
Power Dissipation at T_A = 25°C	900 mW
Load Current	30 mA
Operating Junction Temperature Range	
XR-4194M	−55°C to +150°C
XR-4194CN	0°C to +125°C
Storage Temperature Range	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-4194 is a dual polarity tracking voltage regulator. An on board reference, set by a single resistor, determines both output voltages. Tracking accuracy is better than 1%. Non-symmetrical output voltages are obtained by connecting a resistor to the balance adjust (Pin 4). Internal protection circuits include thermal shutdown and active current limiting.

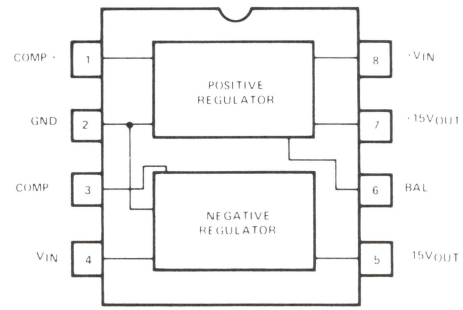
±15V Dual-Tracking Voltage Regulator

GENERAL DESCRIPTION

The XR-4195 is a dual-polarity tracking regulator designed to provide balanced positive and negative 15V output voltages at currents of up to 100mA.

The device is ideal for local "on-card" regulation, which eliminates the distribution problems associated with single-point regulation. Intended for ease of application, the XR-4195 requires only two external components for operation.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Direct Replacement for RM/RC 4195
±15V Operational Amplifier Power
Thermal Shutdown at T_j = +175°C
Output Currents to 100mA
As a Single Output Regulator, it may be used with up to +50V Output
Available in 8-Pin Plastic Mini-DIP
Low External Parts Count

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4195CP	Dip	0°C to +70°C

APPLICATIONS

Operational Amplifier Supply
On-Card Regulation
Regulating High Voltage

ABSOLUTE MAXIMUM RATINGS

Input Voltage ±V to Ground	±30 V
Power Dissipation at T_A = 25°C	600 mW
Load Current	100 mA
Operating Junction Temperature Range	0°C to +125°C
Storage Temperature Range	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-4195 is a dual polarity tracking voltage regulator, internally trimmed to ±15V. Only output capacitors are required for operation. Internal protection circuits include thermal shutdown and active current limiting. The device may be configured as a single output high voltage regulator by adding a voltage divider between an output pin, the device ground (Pin 2) and system ground.

EXAR

Section 6—Instrumentation Circuits

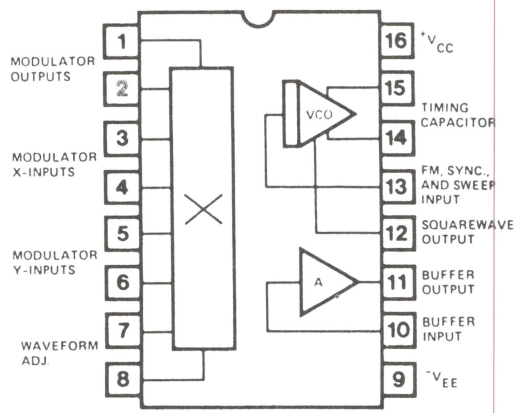
Monolithic Waveform Generator

GENERAL DESCRIPTION

The XR-205 is a highly versatile, monolithic waveform generator designed for diverse applications in communication and telemetry equipment, as well as in systems design and testing. It is a self-contained, totally monolithic signal generator that provides sine, square, triangle, ramp and sawtooth output waveforms, which can be both amplitude and frequency modulated.

The circuit has three separate sections: a voltage-controlled oscillator (VCO) which generates the basic periodic waveforms; a balanced modulator which provides amplitude or phase modulation; a buffer amplifier section which provides a low impedance output with high current drive capability.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

High Frequency Operation
AM and FM Capabilities
Sine, Triangle, Square, Sawtooth, Ramp and Pulse Waveforms
Wide Supply Range 8 V to 26 V
Split Supply Capability

APPLICATIONS

Waveform Generation

Sinewave	Sawtooth
Triangle	Ramp
Square	Pulse

AM Generation Double Sideband Suppressed Carrier
FM Generation
Sweep Generation
Tone Burst Generation
Simultaneous AM/FM
Frequency-Shift Keyed (FSK) Signal Generation
Phase-Shift Keyed (PSK) Signal Generation
On-Off Keyed Oscillation
Clock Generation

ABSOLUTE MAXIMUM RATINGS

Power Supply	26 Volts
Power Dissipation	750 mW
Derate above +25°C	6 mW/°C
Temperature	
Storage	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-205	Ceramic	0°C to + 70°C

SYSTEM DESCRIPTION

The XR-205 is a high frequency monolithic function generator capable of sine, square, triangle, ramp, sawtooth, and pulse waveforms with frequencies ranging to 4 MHz. Operating frequency is determined by a single capacitor and may be externally swept over a 10:1 range. Duty cycle is variable from 10% to 90%. Amplitude modulation, up to 100%, is accomplished using the modulator X inputs (Pins 3 and 4). The on board buffer amplifier features 50Ω output resistance and 20 mA output capability. The XR-205 operates with either single or split supplies.

Monolithic Function Generator

GENERAL DESCRIPTION

The XR-2206 is a monolithic function generator integrated circuit capable of producing high quality sine, square, triangle, ramp, and pulse waveforms of high-stability and accuracy. The output waveforms can be both amplitude and frequency modulated by an external voltage. Frequency of operation can be selected externally over a range of 0.01 Hz to more than 1 MHz.

The circuit is ideally suited for communications, instrumentation, and function generator applications requiring sinusoidal tone, AM, FM, or FSK generation. It has a typical drift specification of 20 ppm/°C. The oscillator frequency can be linearly swept over a 2000:1 frequency range, with an external control voltage, having a very small affect on distortion.

FEATURES

Low-Sine Wave Distortion	0.5%, Typical
Excellent Temperature Stability	20 ppm/°C, Typical
Wide Sweep Range	2000:1, Typical
Low-Supply Sensitivity	0.01%V, Typical
Linear Amplitude Modulation	
TTL Compatible FSK Controls	
Wide Supply Range	10V to 26V
Adjustable Duty Cycle	1% to 99%

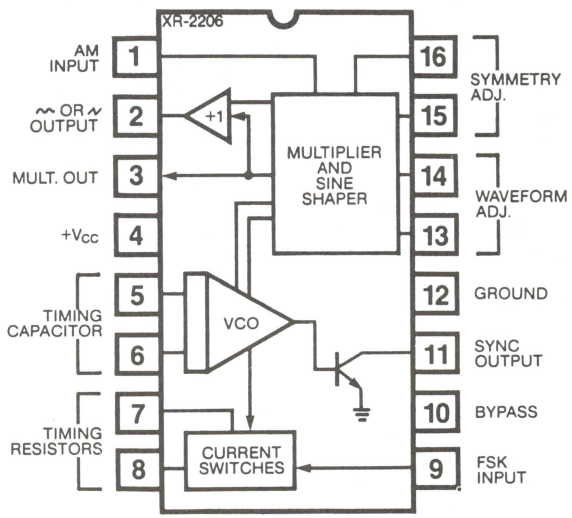
APPLICATIONS

Waveform Generation
Sweep Generation
AM/FM Generation
V/F Conversion
FSK Generation
Phase-Locked Loops (VCO)

ABSOLUTE MAXIMUM RATINGS

Power Supply	26V
Power Dissipation	750 mW
Derate Above 25°C	5 mW/°C
Total Timing Current	6 mA
Storage Temperature	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2206M	Ceramic	−55°C to +125°C
XR-2206N	Ceramic	0°C to +70°C
XR-2206P	Plastic	0°C to +70°C
XR-2206CN	Ceramic	0°C to +70°C
XR-2206CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2206 is comprised of four functional blocks; a voltage-controlled oscillator (VCO), an analog multiplier and sine-shaper; a unity gain buffer amplifier; and a set of current switches.

The VCO actually produces an output frequency proportional to an input current, which is produced by a resistor from the timing terminals to ground. The current switches route one of the timing pins current to the VCO controlled by an FSK input pin, to produce an output frequency. With two timing pins, two discrete output frequencies can be independently produced for FSK Generation Applications.

Voltage-Controlled Oscillator

GENERAL DESCRIPTION

The XR-2207 is a monolithic voltage-controlled oscillator (VCO) integrated circuit featuring excellent frequency stability and a wide tuning range. The circuit provides simultaneous triangle and squarewave outputs over a frequency range of 0.01 Hz to 1 MHz. It is ideally suited for FM, FSK, and sweep or tone generation, as well as for phase-locked loop applications.

The XR-2207 has a typical drift specification of 20 ppm/°C. The oscillator frequency can be linearly swept over a 1000:1 range with an external control voltage; and the duty cycle of both the triangle and the squarewave outputs can be varied from 0.1% to 99.9% to generate stable pulse and sawtooth waveforms.

FEATURES

Excellent Temperature Stability (20 ppm/°C)
Linear Frequency Sweep
Adjustable Duty Cycle (0.1% to 99.9%)
Two or Four Level FSK Capability
Wide Sweep Range (1000:1 Min)
Logic Compatible Input and Output Levels
Wide Supply Voltage Range (±4V to ±13V)
Low Supply Sensitivity (0.1%/V)
Wide Frequency Range (0.01 Hz to 1 MHz)
Simultaneous Triangle and Squarewave Outputs

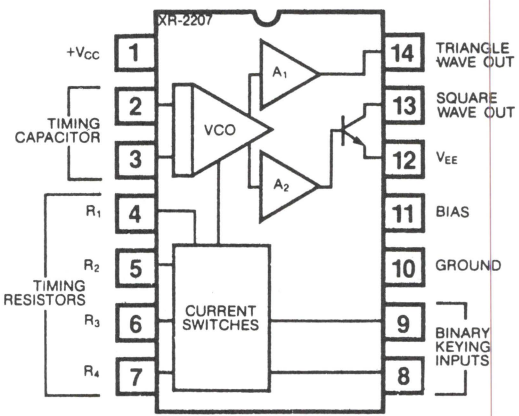
APPLICATIONS

FSK Generation
Voltage and Current-to-Frequency Conversion
Stable Phase-Locked Loop
Waveform Generation
  Triangle, Sawtooth, Pulse, Squarewave
FM and Sweep Generation

ABSOLUTE MAXIMUM RATINGS

Power Supply	26V
Power Dissipation (package limitation)	
Ceramic package	750 mW
Derate above +25°C	6.0 mW/°C
Plastic package	625 mW
Derate above +25°C	5 mW/°C
Storage Temperature Range	-65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR2207M	Ceramic	-55°C to +125°C
XR2207N	Ceramic	0°C to +70°C
XR2207P	Plastic	0°C to +70°C
XR2207CN	Ceramic	0°C to +70°C
XR2207CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2207 utilizes four main functional blocks for frequency generation. These are a voltage controlled oscillator (VCO), four current switches which are activated by binary keying inputs, and two buffer amplifiers for triangle and squarewave outputs. The VCO is actually a current controlled oscillator which gets its input from the current switches. As the output frequency is proportional to the input current, the VCO produces four discrete output frequencies. Two binary input pins determine which timing currents are channelled to the VCO. These currents are set by resistors to ground from each of the four timing terminals.

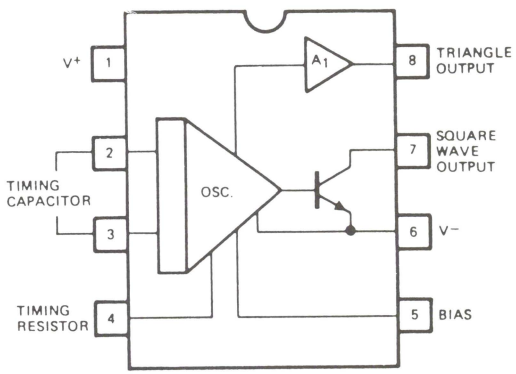
The triangle output buffer provides a low impedance output (10Ω TYP) while the squarewave is an open-collector type. A programmable reference point allows the XR-2207 to be used in either single or slip supply configurations.

Precision Oscillator

GENERAL DESCRIPTION

The XR-2209 is a monolithic variable frequency oscillator circuit featuring excellent temperature stability and a wide linear sweep range. The circuit provides simultaneous triangle and squarewave outputs over a frequency range of 0.01 Hz to 1 MHz. The frequency is set by an external RC product. It is ideally suited for frequency modulation, voltage to frequency or current to frequency conversion, sweep or tone generation as well as for phase-locked loop applications when used in conjunction with a phase comparator such as the XR-2208.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Excellent Temperature Stability (20 ppm/°C)
Linear Frequency Sweep
Wide Sweep Range (1000:1 Min)
Wide Supply Voltage Range (±4V to ±13V)
Low Supply Sensitivity (0.15%/V)
Wide Frequency Range (0.01 Hz to 1 MHz)
Simultaneous Triangle and Squarewave Outputs

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2209M	Ceramic	−55°C to +125°C
XR-2209CN	Ceramic	0°C to +70°C
XR-2209CP	Plastic	0°C to +70°C

APPLICATIONS

Voltage and Current-to-Frequency Conversion
Stable Phase-Locked Loop
Waveform Generation
FM and Sweep Generation

ABSOLUTE MAXIMUM RATINGS

Power Supply	26 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate above +25°C	2.5 mW/°C
Operating Temperatue Range	
XR-2209M	−55°C to +125°C
XR-2209C	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-2209 precision oscillator is comprised of three functional blocks: a variable frequency oscillator which generates the basic periodic waveforms and two buffer amplifiers for the triangle and the squarewave outputs. The oscillator frequency, set by an external capacitor, C, and the timing resistor, R, operates over 8 frequency decades, from 0.01 Hz to 1 MHz. With no sweep signal applied, the frequency of oscillation is equal to 1/RC.

The XR-2209 has a typical drift specification of 20 ppm/°C. Its frequency can be linearly swept over a 1000:1 range with an external control signal. Output duty cycle is adjustable from less than 1% to over 99%. The device may operate from either single or split supplies from 8 V to 26 V (±4 V to ±13 V).

Precision Waveform Generator

GENERAL DESCRIPTION

The XR-8038 is a precision waveform generator IC capable of producing sine, square, triangular, sawtooth and pulse waveforms with a minimum number of external components and adjustments. Its operating frequency can be selected over nine decades of frequency, from 0.001 Hz to 1 MHz by the choice of external R-C components. The frequency of oscillation is highly stable over a wide range of temperature and supply voltage changes. The frequency control, sweep and modulation can be accomplished with an external control voltage, without affecting the quality of the output waveforms. Each of the three basic waveforms, i.e., sinewave, triangle and square wave outputs are available simultaneously, from independent output terminals.

The XR-8038 monolithic waveform generator uses advanced processing technology and Schottky-barrier diodes to enhance its frequency performance. It can be readily interfaced with a monolithic phase-detector circuit, such as the XR-2208, to form stable phase-locked loop circuits.

FEATURES

Direct Replacement for Intersil 8038
Low Frequency Drift—50 ppm/°C Max.
Simultaneous Sine, Triangle and Square-Wave Outputs
Low Distortion—THD ≃ 1%
High FM and Triangle Linearity
Wide Frequency Range—0.001 Hz to 1 MHz
Variable Duty-Cycle—2% to 98%

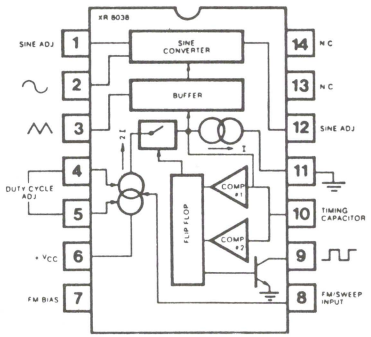
APPLICATIONS

Precision Waveform Generation Sine, Triangle, Square, Pulse
Sweep and FM Generation
Tone Generation
Instrumentation and Test Equipment Design
Precision PLL Design

ABSOLUTE MAXIMUM RATINGS

Power Supply	36V
Power Dissipation (package limitation)	
Ceramic package	750 mW
Derate above +25°C	6.0 mW/°C
Plastic package	625 mW
Derate above +25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-8038M	Ceramic	−55°C to +125°C
XR-8038N	Ceramic	0°C to +70°C
XR-8038P	Plastic	0°C to +70°C
XR-8038CN	Ceramic	0°C to +70°C
XR-8038CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-8038 precision waveform generator produces highly stable and sweepable square, triangle and sine waves across nine frequency decades. The device time base employs resistors and a capacitor for frequency and duty cycle determination. The generator contains dual comparators, a flip-flop driving a switch, current sources, a buffer amplifier and a sine wave converter. Three identical frequency waveforms are simultaneously available. Supply voltage can range from 10V to 30V, or ±5V with dual supplies.

Unadjusted sine wave distortion is typically less than 0.7%, with Pin 1 open and 8 kΩ from Pin 12 to Pin 11 ($-V_{EE}$ or ground). Sine wave distortion may be improved by including two 100 kΩ potentiometers between V_{CC} and V_{EE} (or ground), with one wiper connected to Pin 1 and the other connected to Pin 12.

Frequency sweeping or FM is accomplished by applying modulation to Pins 7 and 8 for small deviations, or only to Pin 8 for large shifts. Sweep range typically exceeds 1000:1.

The square wave output is an open collector transistor; output amplitude swing closely approaches the supply voltage. Triangle output amplitude is typically 1/3 of the supply, and sine wave output reaches 0.22 V_S.

Precision Waveform Generator

GENERAL DESCRIPTION

The XR-8038A is a precision waveform generator IC capable of producing sine, square, triangular, sawtooth, and pulse waveforms, with a minimum number of external components and adjustments. The 8038A allows the elimination of the external distortion adjusting resistor which greatly improves the temperature drift of distortion, as well as lowering external parts count. Its operating frequency can be selected over nine decades of frequency, from 0.001 Hz to 1 MHz, by the choice of external R-C components. The frequency of oscillation is highly stable over a wide range of temperature and supply voltage changes. The frequency control, the sweep, and the modulation can be accomplished with an external control voltage, without affecting the quality of the output waveforms. Each of the three basic waveform outputs, (i.e., sine, triangle and square) are simultaneously available from independent output terminals.

The XR-8038A monolithic waveform generator uses advanced processing technology and Schottky-barrier diodes to enhance its frequency performance. It can be readily interfaced with a monolithic phase-detector circuit, such as the XR-2228 to form stable phase-locked circuits.

FEATURES

Low Frequency Drift 50 ppm/°C, Typical
Simultaneous Sine, Triangle, and Square Wave Outputs
Low Distortion THD 1%
High FM and Triangle Linearity
Wide Frequency Range 0.001 Hz to 1 MHz, Typical
Variable Duty Cycle 2% to 98%
Low Distortion Variation with Temperature

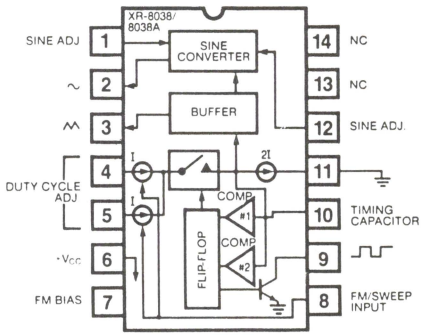
APPLICATIONS

Precision Waveform Generation
Sweep and FM Generation
Tone Generation
Instrumentation and Test Equipment Design
Precision PLL Design

ABSOLUTE MAXIMUM RATINGS

Power Supply	36V
Power Dissipation (package limitation)	
Ceramic Package	750 mW
Derate Above +25°C	6.0 mW/°C
Plastic Package	625 mW
Derate Above +25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-8038AM	Ceramic	−55°C to +125°C
XR-8038AN	Ceramic	0°C to +70°C
XR-8038AP	Plastic	0°C to +70°C
XR-8038ACN	Ceramic	0°C to +70°C
XR-8038ACP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-8038A precision waveform generator produces highly stable and sweepable square, triangle, and sine waves across nine frequency decades. The XR-8038A is an advanced version of the XR-8038, with improved sine distortion temperature drift. The device time base employs resistors and a capacitor for frequency and duty cycle determination. The generator contains dual comparators, a flip-flop driving a switch, current sources, a buffer amplifier, and a sine wave convertor. Three identical frequency outputs are simultaneously available. Supply voltage can range from 10V to 30V, or ±5V to ±15V with dual supplies.

Unadjusted sine wave distortion is typically less than 0.7% with the sine wave distortion adjust pin (Pin 1) open. Distortion levels may be improved by including a 100kΩ potentiometer between the supplies, with the wiper connected to Pin 1.

Frequency sweeping or FM is accomplished by applying modulation to Pins 7 and 8 for small deviations, or only Pin 8 for large shifts. Sweep range typically exceed 1000:1.

The square wave output is an open collector transistor; output amplitude swing closely approaches the supply voltage. Triangle output amplitude is typically 1/3 of the supply, and sine wave output reaches $0.22V_S$.

Section 6—Instrumentation Circuits

Operational Multiplier

GENERAL DESCRIPTION

The XR-2208 operational multiplier combines a four-quadrant analog multiplier (or modulator), a high frequency buffer amplifier, and an operational amplifier in a monolithic circuit that is ideally suited for both analog computation and communications signal processing application. As shown in the functional block diagram, for maximum versatility the multiplier and operational amplifier sections are not internally connected. They can be interconnected, with a minimum number of external components, to perform arithmetic computation, such as multiplication, division, square-root extraction. The operational amplifier can also function as a preamplifier for low-level input signals, or as a post detection amplifier for synchronous demodulator applications. For signal processing, the high frequency buffer amplifier output is available at pin 15. This multiplier/buffer amplifier combination extends the small signal 3-db bandwidth to 8-MHz and the transconductance bandwidth to 100 MHz.

The XR-2208 operates over a wide range of supply voltages, ±4.5V to ±16V. Current and voltage levels are internally regulated to provide excellent power supply rejection and temperature stability. The XR-2208 operates over a 0°C to 70°C temperature range. The XR-2208M is specified for operation over the military temperature range of −55°C to +125°C.

FEATURES

Maximum Versatility
- Independent Multiplier, Op Amp, and Buffer

Excellent Linearity (0.3% typ.)
Wide Bandwidth
- 3 dB B.W.—8 MHz typ.
- 3° Phase Shift B.W.—1.2 MHz typ.
- Transconductance B.W.—100 MHz typ.

Simplified Offset Adjustments
Wide Supply Voltage Range (±4.5V to ±16V)

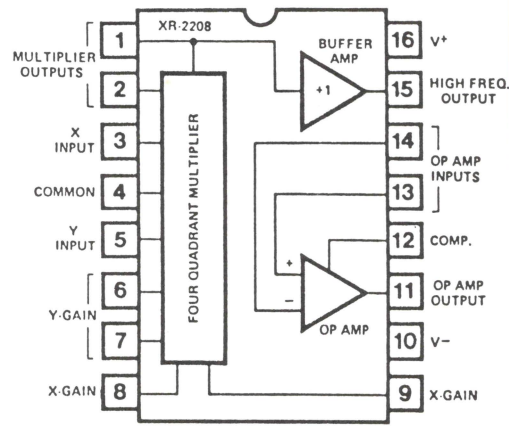
APPLICATIONS

Analog Computation
- Multiplication
- Division
- Squaring
- Square-Root

Signal Processing
- AM Generation
- Frequency Doubling
- Frequency Translation
- Synchronous AM Detection
- Triangle-to-Sinewave Converter
- AGC Amplifier
- Phase Detector

Phase-Locked Loop (PLL) Applications
- Motor Speed Control
- Precision PLL
- Carrier Detection
- Phase-Locked AM Demodulation

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply V+	+18 Volts
V−	−18 Volts
Power Dissipation	
Ceramic Package	750mW
Derate above +25°C	6mW/°C
Plastic Package	625 mW
Derate above +25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2208M	Ceramic	−55°C to +125°C
XR-2208N	Ceramic	0°C to +70°C
XR-2208P	Plastic	0°C to +70°C
XR-2208CN	Ceramic	0°C to +70°C
XR-2208CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2228 multiplier/detector contains a four quadrant multiplier and a fully independent operational amplifier. The four quadrant multiplier has fully differential X and Y inputs and outputs. Both inputs have 3 MHz dynamic response and 100 MHz transconductance bandwidth. The operational amplifier features high gain and a large common mode range. The device is powered by 4.5V to 16V split supplies.

For higher frequency applications, consider the XR-2208.

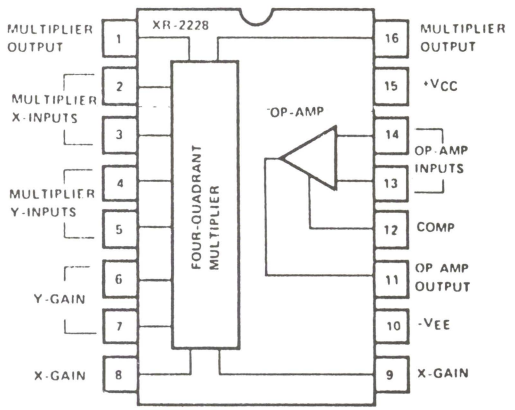
Monolithic Multiplier/Detector

GENERAL DESCRIPTION

The XR-2228 is a monolithic multiplier/detector circuit especially designed for interfacing with integrated phase-locked loop (PLL) circuits, to perform synchronous AM detection and triangle-to-sinewave conversion. It combines a four-quadrant analog multiplier (or modulator) and a high-gain operational amplifier in a single monolithic circuit.

As shown in the equivalent schematic diagram, the four-quadrant multiplier section is designed with fully differential X- and Y-inputs and differential outputs. For maximum versatility, the multiplier and the operational amplifier sections are not internally connected. The operational amplifier can also function as a pre-amplifier for low-level input signals, or as a post-detection amplifier for synchronous demodulation, phase-detection or for sine-shaper applications.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Independent Multiplier and Op Amp Sections
Differential X and Y Inputs
Interfaces with all PLL and VCO Circuits
Wide Common Mode Range
Wide Transconductance Bandwidth (100 MHz, Typ.)
Wide Supply Voltage Range (±4.5V to ±16V)

APPLICATIONS

Phase-Locked Loop Design
Phase Detection
Synchronous AM Detection
AM Generation
Triangle-to-Sinewave Conversion
Frequency Translation

ABSOLUTE MAXIMUM RATINGS

Power Supply	±18 Volts
Power Dissipation	
Ceramic Package	750 mW
Derate above +25°C	6 mW/°C
Plastic Package	625 mW
Derate above +25°C	5 mW/°C
Storage Temperature Range	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2228M	Ceramic	−55°C to +125°C
XR-2228N	Ceramic	−40°C to +85°C
XR-2228P	Plastic	−40°C to +85°C
XR-2228CN	Ceramic	0°C to +70°C
XR-2228CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2228 multiplier/detector contains a four quadrant multiplier and a fully independent operational amplifier. The four quadrant multiplier has fully differential X and Y inputs and outputs. Both inputs have 3 MHz dynamic response and 100 MHz transconductance bandwidth. The operational amplifier features high gain and a large common mode range. The device is powered by 4.5V to 16V split supplies.

For higher frequency applications, consider the XR-2208.

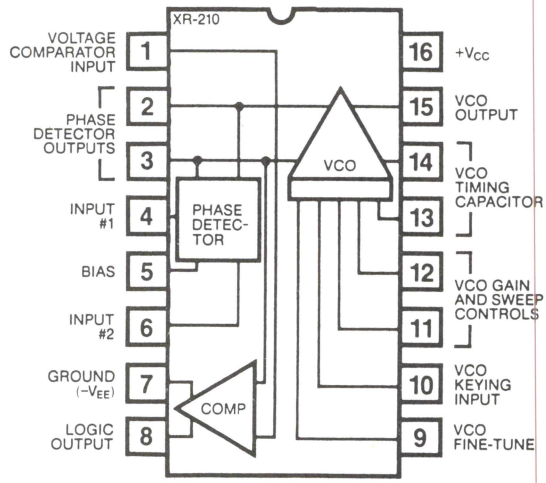
Section 6—Instrumentation Circuits

FSK Modulator/Demodulator

GENERAL DESCRIPTION

The XR-210 is a highly versatile monolithic phase-locked loop system, especially designed for data communications. It is particularly well suited for FSK modulation/demodulation (MODEM) applications, frequency synthesis, tracking filters, and tone decoding. The XR-210 operates over a power supply range of 5V to 26V, and over a frequency band of 0.5 Hz to 20 MHz. The circuit can accommodate analog signals between 300 μV and 3V, and can interface with conventional DTL, TTL, and ECL logic families.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Wide Frequency Range	0.5 Hz to 20 MHz
Wide Supply Voltage Range	5V to 26V
Digital Programming Capability	
RS-232C Compatible Demodulator Output	
DTL, TTL and ECL Logic Compatibility	
Wide Dynamic Range	300 μV to 3V
ON-OFF Keying & Sweep Capability	
Wide Tracking Range	±1% to ±50%
Good Temperature Stability	200 ppm/°C
High-Current Logic Output	50 mA
Independent "Mark" and "Space" Frequency Adjustment	
VCO Duty Cycle Control	

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-210M	Ceramic	−55°C to +125°C
XR-210CN	Ceramic	0°C to +70°C

APPLICATIONS

Data Synchronization
Signal Conditioning
FSK Generation
Tone Decoding
Frequency Synthesis
FSK Demodulation
Tracking Filter
FM Detection
FM and Sweep Generation
Wideband Discrimination

ABSOLUTE MAXIMUM RATINGS

Power Supply	26 Volts
Power Dissipation	750 mW
Derate Above +25°C	6.0 mW/°C
Storage Temperature	−65°C to +150°C

SYSTEM DESCRIPTION

The XR-210 is made up of a stable wide-range voltage-controlled oscillator (VCO), exclusive OR gate type phase detector, and an analog voltage comparator. The VCO, which produces a square wave as an output, is either used in conjunction with the phase detector to form a phase-locked loop (PLL) for FSK demodulation and tone detection or as a generator in FSK modulation schemes. The phase detector when used in the PLL configuration produces a differentional output voltage with a 6 KΩ output impedance, which when capacitively loaded forms a single pole loop filter. The voltage comparator is used to sense the phase detector output and produces the output in the FSK demodulation connection.

Monolithic Phase-Locked Loop

The XR-215 is a highly versatile monolithic phase-locked loop (PLL) system designed for a wide variety of applications in both analog and digital communication systems. It is especially well suited for FM or FSK demodulation, frequency synthesis and tracking filter applications. The XR-215 can operate over a large choice of power supply voltages ranging from 5 V to 26 V and a wide frequency band of 0.5 Hz to 35 MHz. It can accommodate analog signals between 300 microvolts and 3 volts and can interface with conventional DTL, TTL, and ECL logic families.

FEATURES

Wide Frequency Range: 0.5 Hz to 35 MHz
Wide Supply Voltage Range: 5V to 26V
Digital Programming Capability
DTL, TTL and ECL Logic Compatibility
Wide Dynamic Range: 300 μV to 3V
ON-OFF Keying and Sweep Capability
Wide Tracking Range: Adjustable from ±1% to ±50%
High-Quality FM Detection: Distortion 0.15%
Signal/Noise 65dB

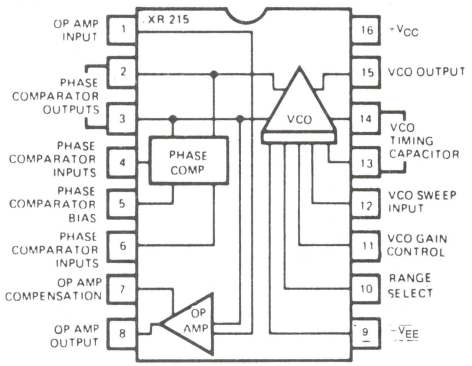
APPLICATIONS

FM Demodulation
Frequency Synthesis
FSK Coding/Decoding (MODEM)
Tracking Filters
Signal Conditioning
Tone Decoding
Data Synchronization
Telemetry Coding/Decoding
FM, FSK and Sweep Generation
Crystal Controlled Detection
Wideband Frequency Discrimination
Voltage-to-Frequency Conversion

ABSOLUTE MAXIMUM RATINGS

Power Supply	26 volts
Power Dissipation	750 mW
Derate above +25°C	5 mW/°C
Temperature	
Storage	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-215CN	Ceramic	0°C to 70°C

SYSTEM DESCRIPTION

The XR-215 monolithic PLL system consists of a balanced phase comparator, a highly stable voltage-controlled oscillator (VCO) and a high speed operation amplifier. Figure 1 depicts the functional block diagram of the circuit. The phase comparator outputs are internally connected to the VCO inputs and to the non-inverting input of the operational amplifier. A self-contained PLL System is formed by simple AC coupling the VCO output to either of the phase comparator inputs and adding a low-pass filter to the phase comparator output terminals.

The VCO section has frequency sweep, on-off keying, sync, and digital programming capabilities. Its frequency is highly stable and is determined by a single exernal capacitor. The operational amplifier can be used to for audio preamplification in FM detector applications or as a high speed sense amplifier (or comparator) in FSK demodulation.

FSK Demodulator/Tone Decoder

GENERAL DESCRIPTION

The XR-2211 is a monolithic phase-locked loop (PLL) system especially designed for data communications. It is particularly well suited for FSK modem applications. It operates over a wide supply voltage range of 4.5 to 20V and a wide frequency range of 0.01 Hz to 300 kHz. It can accommodate analog signals between 2 mV and 3V, and can interface with conventional DTL, TTL, and ECL logic families. The circuit consists of a basic PLL for tracking an input signal within the pass band, a quadrature phase detector which provides carrier detection, and an FSK voltage comparator which provides FSK demodulation. External components are used to independently set center frequency, bandwidth, and output delay. An internal voltage reference proportional to the power supply provides ratio metric operation for low system performance variations with power supply changes.

The XR-2211 is available in 14 pin DIP ceramic or plastic packages specified for commercial or military temperature ranges.

FEATURES

Wide Frequency Range	0.01 Hz to 300 kHz
Wide Supply Voltage Range	4.5V to 20 V
DTL/TTL/ECL Logic Compatibility	
FSK Demodulation, with Carrier Detection	
Wide Dynamic Range	2 mV to 3 V rms
Adjustable Tracking Range (±1% to ±80%)	
Excellent Temp. Stability	20 ppm/°C, typ.

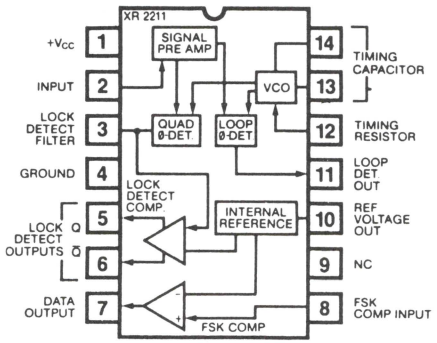
APPLICATIONS

FSK Demodulation
Data Synchronization
Tone Decoding
FM Detection
Carrier Detection

ABSOLUTE MAXIMUM RATINGS

Power Supply	20V
Input Signal Level	3V rms
Power Dissipation	
Ceramic Package	750 mW
Derate Above T_A = +25°C	6 mV/°C
Plastic Package	
Derate Above T_A = +25°C	5.0 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2211M	Ceramic	−55°C to +125°C
XR-2211CN	Ceramic	0°C to +70°C
XR-2211CP	Plastic	0°C to +70°C
XR-2211N	Ceramic	−40°C to +85°C
XR-2211P	Plastic	−40°C to +85°C

SYSTEM DESCRIPTION

The main PLL within the XR-2211 is constructed from an input preamplifier, analog multiplier used as a phase detector, and a precision voltage controlled oscillator (VCO). The preamplifier is used as a limiter such that input signals above typically 2mV RMS are amplified to a constant high level signal. The multiplying-type phase detector acts as a digital exclusive or gate. Its output (unfiltered) produces sum and difference frequencies of the input and the VCO output, f input + f input (2f input) and f input - f input (0 Hz) when the phase detector output to remove the "sum" frequency component while passing the difference (DC) component to drive the VCO. The VCO is actually a current controlled oscillator with its nominal input current (f_0) set by a resistor (R_0) to ground and its driving current with a resistor (R_1) from the phase detector.

The other sections of the XR-2211 act to: determine if the VCO is driven above or below the center frequency (FSK comparator); produced both active high and active low outputs to indicate when the main PLL is in lock (quadrature phase detector and lock detector comparator).

Precision Phase-Locked Loop

GENERAL DESCRIPTION

The XR-2212 is an ultra-stable monolithic phase-locked loop (PLL) system especially designed for data communications and control system applications. Its on board reference and uncommitted operational amplifier, together with a typical temperature stability of better than 20 ppm/°C, make it ideally suited for frequency synthesis, FM detection, and tracking filter applications. The wide input dynamic range, large operating voltage range, large frequency range, and ECL, DTL, and TTL compatibility contribute to the usefulness and wide applicability of this device.

FEATURES

Quadrature VCO Outputs	
Wide Frequency Range	0.01 Hz to 300 kHz
Wide Supply Voltage Range	4.5V to 20V
DTL/TTL/ECL Logic Compatibility	
Wide Dynamic Range	2 mV to 3 Vrms
Adjustable Tracking Range (±1% to ±80%)	
Excellent Temp. Stability	20 ppm/°C, Typ.

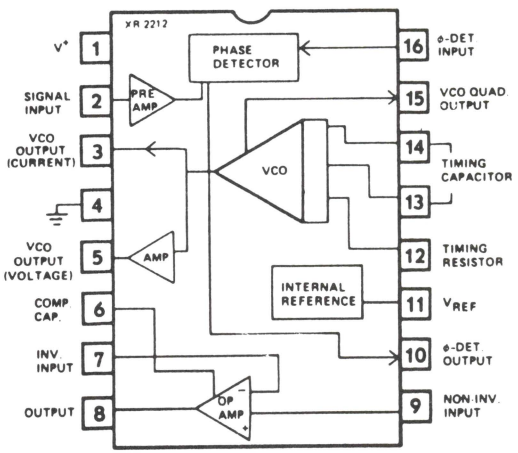
APPLICATIONS

Frequency Synthesis
Data Synchronization
FM Detection
Tracking Filters
FSK Demodulation

ABSOLUTE MAXIMUM RATINGS

Power Supply	18V
Input Signal Level	3 Vrms
Power Dissipation	
Ceramic Package:	750 mW
Derate Above T_A = +25°C	6 mW/°C
Plastic Package:	625 mW
Derate Above T_A = +25°C	5 mW/°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2212M	Ceramic	−55°C to +125°C
XR2212CN	Ceramic	0°C to +70°C
XR-2212CP	Plastic	0°C to +70°C
XR-2212N	Ceramic	−40°C to +85°C
XR-2212P	Plastic	−40°C to +85°C

SYSTEM DESCRIPTION

The XR-2212 is a complete PLL system with buffered inputs and outputs, an internal reference, and an uncommited op amp. Two VCO outputs are pinned out; one sources current, the other sources voltage. This enables operation as a frequency synthesizer using an external programmable divider. The op amp section can be used as an audio preamplifier for FM detection or as a high speed sense amplifier (comparator) for FSK demodulation. The center frequency, bandwidth, and tracking range of the PLL are controlled independantly by external components. The PLL output is directly compatible with MOS, DTL, ECL, and TTL logic families as well as microprocessor peripheral systems.

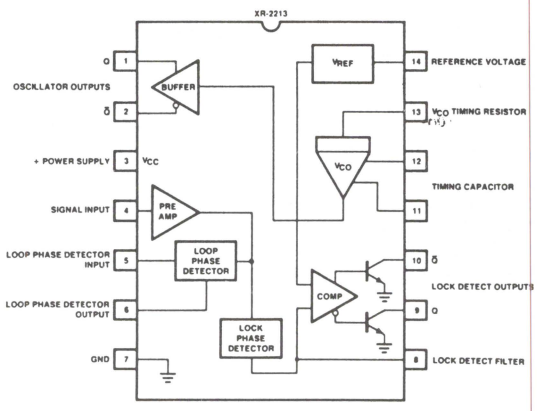
The precision PLL system operates over a supply voltage range of 4.5 V to 20 V, a frequency range of 0.01 Hz to 300 kHz, and accepts input signals in the range of 2 mV to 3 Vrms. Temperature stability of the VCO is typically better than 20 ppm/°C.

Precision Phase-Locked Loop/Tone Decoder

GENERAL DESCRIPTION

The XR-2213 is a highly stable phase-locked loop (PLL) system designed for control systems and tone detection applications. It combines the features of the XR-2211 and XR-2212 into a single monolithic IC. The circuit consists of a high stability VCO, input preamplifier, phase detector, quadrature phase detector, and high gain voltage comparator. Initial VCO frequency accuracy and supply rejection are an order of magnitude better than industry standards like the 567 decoder. An on board reference contributes to reliable operation and complementary outputs aid applicability.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Wide Frequency Range	0.01 Hz to 300 kHz
Wide Supply Voltage Range	4.5 V to 15 V
Uncommitted V_{CO} Q and $\overline{Q}$ Outputs	
Wide Dynamic Input Voltage Range	2mV to 3 V RMS
Excellent V_{CO} Stability	20 PPM/°C Typ.

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2213M	Ceramic	−55°C to +125°C
XR-2213CN	Ceramic	0°C to + 70°C
XR-2213CP	Plastic	0°C to + 70°C
XR-2213N	Ceramic	−40°C to + 85°C
XR-2213P	Plastic	−40°C to + 85°C

APPLICATIONS

Tone Detection
Frequency Synthesis
FM Detection
Tracking Filters

ABSOLUTE MAXIMUM RATINGS

Power Supply	15 V
Input Signal Level	3 V RMS
Power Dissipation	
Ceramic Package:	750 mW
Derate Above T_A = +25°C	6 mW/°C
Plastic Package:	625 mW
Derate Above T_A = +25°C	5 mW/°C
Storage Temperature	−55°C to +150°C

SYSTEM DESCRIPTION

The XR-2213 is a complete PLL system including circuitry enabling dedicated tone detection capability over a frequency range of 0.01 Hz to 300 kHz. Supply voltage may range from 4.5 V to 15 V.

The input preamplifier has a dynamic range of 2 mV to 3 Vrms. The high stability VCO, with buffered complementary outputs, typically features better than 20 ppm/°C temperature drift and 0.05%/V supply rejection. An on board voltage reference is provided, and can sink 2 mA. The complementary lock detect outputs are each capable of sinking more than 7 mA. All system parameters are independantly determined by external components.

Section 6—Instrumentation Circuits

Monolithic Tone Decoder

GENERAL DESCRIPTION

The XR-567 is a monolithic phase-locked loop system designed for general purpose tone and frequency decoding. The circuit operates over a wide frequency band of 0.01 Hz to 500 kHz and contains a logic compatible output which can sink up to 100 milliamps of load current. The bandwidth, center frequency, and output delay are independently determined by the selection of four external components.

The circuit consists of a phase detector, low-pass filter, and current-controlled oscillator which comprise the basic phase-locked loop; plus an additional low-pass filter and quadrature detector that enables the system to distinguish between the presence or absence of an input signal at the center frequency.

FEATURES

Bandwidth adjustable from 0 to 14%.
Logic compatible output with 100 mA current sinking capability
High stable center frequency.
Center frequency adjustable from 0.01 Hz to 500 kHz
Inherent immunity to false signals
High rejection of out-of-band signals and noise
Frequency range adjustable over 20:1 range by external resistor.

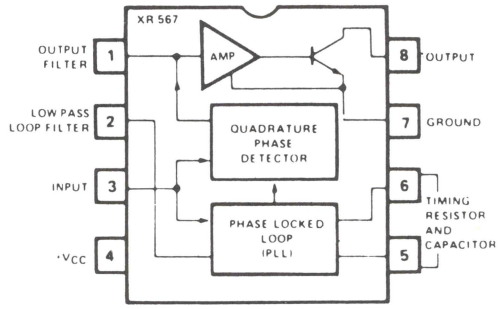
APPLICATIONS

Touch-Tone® Decoding
Sequential Tone Decoding
Communications Paging
Ultrasonic Remote-Control
Telemetry Decoding

ABSOLUTE MAXIMUM RATINGS

Power Supply	10 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate Above +25°C	2.5 mW/°C
Temperature	
Operating	
XR-567M	−55°C to +125°C
XR-567CN/567CP	0°C to +70°C
Storage	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-567M	Ceramic	−55°C to +125°C
XR-567CN	Ceramic	0°C to +70°C
XR-567CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-567 monolithic tone decoder consists of a phase detector, low pass filter, and current controlled oscillator which comprise the basic phase-locked loop, plus an additional low pass filter and quadrature detector enabling detection on in-band signals. The device has a normally high open collector output capable of sinking 100 mA.

The input signal is applied to Pin 3 (20 kΩ nominal input resistance). Free running frequency is controlled by an RC network at Pins 5 and 6 and can typically reach 500 kHz. A capacitor on Pin 1 serves as the output filter and eliminates out-of-band triggering. PLL filtering is accomplished with a capacitor on Pin 2; bandwidth and skew are also dependant upon the circuitry here. Bandwidth is adjustable from 0% to 14% of the center frequency. Pin 4 is $+V_{CC}$ (4.75 to 9V nominal, 10V maximum); Pin 7 is ground; and Pin 8 is open collector output, pulling low when an in-band signal triggers the device.

In applications requiring two or more 567-type devices, consider the XR-2567 dual tone decoder. Where center frequency accuracy and drift are critical, compare the XR-567A. Investigate employing the XR-L567 in low power circuits.

Precision Tone Decoder

GENERAL DESCRIPTION

The XR-567A provides all the necessary circuitry for constructing a variety of tone detectors and frequency decoders. Phase-locked loop circuit techniques are used to provide operation from 0.01 Hz tp 500 kHz. The circuit also features an input preamp, a high-current logic output, and programmable output delay.

The XR-567A, available in an 8-Pin DIL package, is designed to offer improved frequency accuracy and drift characteristics over the standard industry 567. These changes offer improved overall circuit performance, while reducing initial circuit adjustments.

FEATURES

Programmable Detection Bandwidth	0% to 14%
Logic Output	100 mA
Wide Center Frequency Range	0.01 Hz to 500 kHz
High Rejection of Out-of-Band Signals and Noise	
Direct Replacement for standard 567	
Inherent immunity to out-of-band signals & noise	

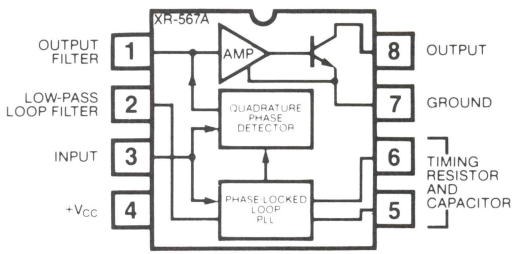
APPLICATIONS

Tone Detection
Touch-Tone® Decoding
Communications Paging
Ultrasonic Remote Control
Precision Oscillator
Wireless Intercom
Carrier-Tone Transceiver
FSK Demodulation
Dual Time Constant Tone Detector

ABSOLUTE MAXIMUM RATINGS

Power Supply	10 volts
Power Dissipation	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate above 25°C	2.5 mW/°C
Operating Temperature Range	
XR-567AM	−55°C to +125°C
XR-567ACN/ACP	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-567AM	Ceramic	−55°C to +125°C
XR-567ACN	Ceramic	0°C to +70°C
XR-567ACP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-567A is an improved version of the popular 567 tone decoder. Center frequency accuracy is guaranteed by design modifications and testing to 5%, and is typically better than 2%. Temperature drift of the center frequency is also improved. Thus, in most applications, no trimming is required.

The XR-567A monolithic tone decoder consists of a phase detector, low pass filter, and current controlled oscillator which comprise the basic phase-locked loop, plus an additional low pass filter and quadrature detector enabling detection of in-band signals. The device has a normally high open collector output capable of sinking 100 mA.

The input signal is applied to Pin 3 (20 kΩ nominal input resistance). Free running frequency is controlled by an RC network at Pins 5 and 6 and can typically reach 500 kHz. A capacitor on Pin 1 serves as the output filter and eliminates out-of-band triggering. PLL filtering is accomplished with a capacitor on Pin 2; bandwidth and skew are also dependant upon the circuitry here. Bandwidth is adjustable from 0% to 14% of the center frequency. Pin 4 is $+V_{CC}$ (4.75 to 9V nominal, 10V maximum); Pin 7 is ground; and Pin 8 is open collector output, pulling low when an in band signal triggers the device.

Micropower Tone Decoder

GENERAL DESCRIPTION

The XR-L567 is a micropower phase-locked loop (PLL) circuit designed for general purpose tone and frequency decoding. In applications requiring very low power dissipation, the XR-L567 can replace the popular 567-type decoder with only minor component value changes. The XR-L567 offers approximately 1/10th the power dissipation of the conventional 567-type tone decoder, without sacrificing its key features such as the oscillator stability, frequency selectivity, and detection threshold. Typical quiescent power dissipation is less than 4 mW at 5 volts. It operates over a wide frequency band of 0.01 Hz to 60 kHz and contains a logic compatible output which can sink up to 10 milliamps of load current. The bandwidth, center frequency, and output delay are independently determined by the selection of four external components.

FEATURES

Very Low Power Dissipation (≈4 mW at 5V).
Bandwidth Adjustable from 0 to 14%.
Logic Compatible Output with 10 mA Current Sinking Capability.
Highly Stable Center Frequency.
Center Frequency Adjustable from 0.01 Hz to 60 kHz.
Inherent Immunity to False Signals.
High Rejection of Out-of-Band Signals and Noise.
Frequency Range Adjustable Over 20:1 Range by External Resistor.

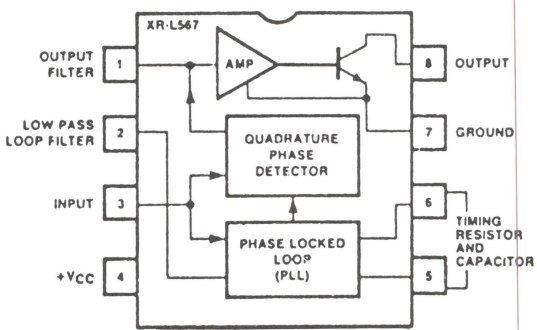
APPLICATIONS

Battery-Operated Tone Detection
Touch-Tone® Decoding
Sequential Tone Decoding
Communications Paging
Ultrasonic Remote-Control
Telemetry Decoding

ABSOLUTE MAXIMUM RATINGS

Power Supply	10 volts
Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
Derate Above +25°C	2.5 mW/°C
Operating Temperature	0°C to +70°C
Storage Temperature	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-L567CN	Ceramic	0°C to +70°C
XR-L567CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-L567 monolithic circuit consists of a phase detector, low pass filter, and current controlled oscillator which comprise the basic phase-locked loop, plus an additional low pass filter and quadrature detector enabling detection of in-band signals. The device has a normally high open collector output.

The input signal is applied to Pin 3 (100 kΩ nominal input resistance). Free running frequency is controlled by an RC network at Pins 5 and 6. A capacitor on Pin 1 serves as the output filter and eliminates out-of-band triggering. PLL filtering is accomplished with a capacitor on Pin 2; band-width and skew are also dependant upon the circuitry here. Pin 4 is $+V_{CC}$ (4.75 to 8V nominal, 10V maximum); Pin 7 is ground; and Pin 8 is the open collector output, pulling low when an in-band signal triggers the device.

The XR-L567 is pin-for-pin compatible with the standard XR-567-type decoder. Internal resistors have been scaled up by a factor of ten, thereby reducing power dissipation and allowing use of smaller capacitors for the same applications compared to the standard part. This scaling also lowers maximum device center frequency and load current sinking capabilities.

Dual Monolithic Tone Decoder

GENERAL DESCRIPTION

The XR-2567 is a dual monolithic tone decoder of the 567-type that is ideally suited for tone or frequency decoding in multiple-tone communication systems. Each decoder of the XR-2567 can be used independently or both sections can be interconnected for dual operation. The matching and temperature tracking characteristics between decoders on this monolithic chip are superior to those available from two separate tone decoder packages.

The XR-2567 operates over a frequency range of 0.01 Hz to 500 kHz. Supply voltages can vary from 4.5V to 12V, with internal voltage regulation provided for supplies between 7V and 12V. Each decoder consists of a phase-locked loop (PLL), a quadrature AM detector, a voltage comparator, and a logic compatible output that can sink more than 100 mA of load current.

The center frequency of each decoder is set by an external resistor and capacitor which determine the free-running frequency of each PLL. When an input tone is present within the passband of the circuit, the PLL "locks" on the input signal. The logic output, which is normally "high", then switches to a "low" state during this "lock" condition.

FEATURES

Replaces two 567-type decoders
Excellent temperature tracking between decoders
Bandwidth adjustable from 0 to 14%
Logic compatible outputs with 100 mA sink capability
Center frequency matching (1% typ.)
Center frequency adjustable from 0.01 Hz to 500 kHz
Inherent immunity to false triggering
Frequency range adjustable over 20:1 range by external resistor.

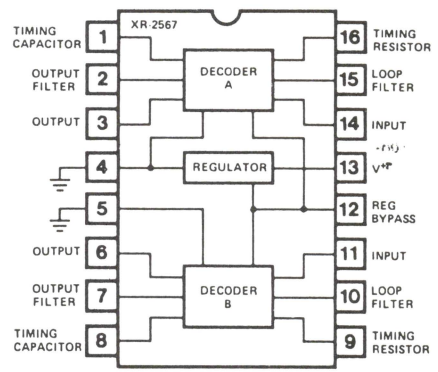
APPLICATIONS

Touch-Tone® Decoding
Sequential Tone Decoding
Dual-Tone Decoding/ Encoding
Communications Paging
Ultrasonic Remote-Control and Monitoring
Full-Duplex Carrier-Tone Transceiver
Wireless Intercom
Dual Precision Oscillator
FSK Generation and Detection

ABSOLUTE MAXIMUM RATINGS

Power Supply	
With Internal Regulator	14V
Without Regulator (Pins 12 and 13 shorted)	10V
Power Dissipation	
Ceramic Package	750 mW
Derate Above +25°C	6 mW/°C
Plastic Package	625 mW/°C
Derate Above +25°C	5.5 mW/°C

FUNCTIONAL BLOCK DIAGRAM



Operating Temperature	
XR-2567M	−55°C to +125°C
XR-2567C	0°C to +70°C
Storage Temperature	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Temperature Range
XR-2567CN	Ceramic	0°C to +70°C
XR-2567CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2567 dual monolithic tone decoder consists of two independant 567-type circuits and an on board voltage regulator. Each decoder has a phase detector, low pass filter, and current controlled oscillator which comprise the basic phase locked loop, plus an additional low pass filter and quadrature detector enabling detection of in-band signals. Both devices have normally high open collector outputs capable of sinking 100 mA.

The input signal is applied to Pin 14 (device A) or Pin 11 (device B), both with 20 kΩ nominal input resistance. Free running frequency is controlled by an RC network at Pins 1 and 16 (device A) or Pins 8 and 9 (device B). A capacitor on Pin 2 (A), or Pin 7 (B) serves as the output filter and eliminates out-of-band triggering. PLL filtering is accomplished with a capacitor on Pin 15 (A), or Pin 10 (B); bandwidth and skew are also dependant upon the circuitry here. Bandwidth is adjustable from 0% to 14% of the center frequency. Pin 13 is $+V_{CC}$ (4.75 to 12V nominal, 14V maximum); Pin 7 is ground; and Pin 3 (A) or Pin 6 (B) is the open collector output, pulling low when an in-band signal triggers the device.

Voltage supplies below 7V necessitate bypassing the internal regulator. This is accomplished by shorting Pin 12 to V_{CC}; for supplies over 7V, a bypass capacitor of at least 1 μF should AC ground Pin 12.

EXAR

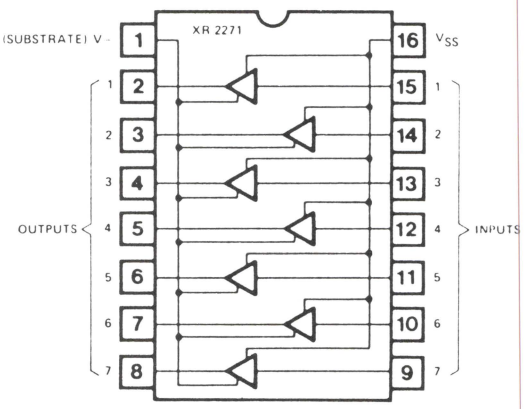
Section 7—Interface Circuits

Fluorescent Display Driver

GENERAL DESCRIPTION

The XR-2271 is a monolithic 7-digit or 7-segment display driver designed to interface MOS logic with fluorescent displays. It features active high logic and low input current. Each XR-2271 is capable of driving seven digits or segments of a display panel and provides complete input and output isolation. Since the output pull up resistors are incorporated on chip, no external parts are required to interface fluorescent displays.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Active High Logic
Low Input Current
Complete Input Output Isolation
Output Pull Up Resistors On Chip
No External Parts Required To Drive
Fluorescent Displays

APPLICATIONS

Fluorescent Display Driver
MOS Logic/High-Voltage Interface

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2271CN	Ceramic	0°C to +70°C
XR-2271CP	Plastic	0°C to +70°C

ABSOLUTE MAXIMUM RATINGS (Note 1)

V_{SS} – V –	50V Max.
Input to V –	50V Max.
Outputs to V –	50V Max.
I_{SS}	20 mA Max.
Power Dissipation $T_A \leq 25°C$	625 mW Max.
Derate above 25°C	5 mW/°C
Storage Temperature	–65°C to +150°C

SYSTEM DESCRIPTION

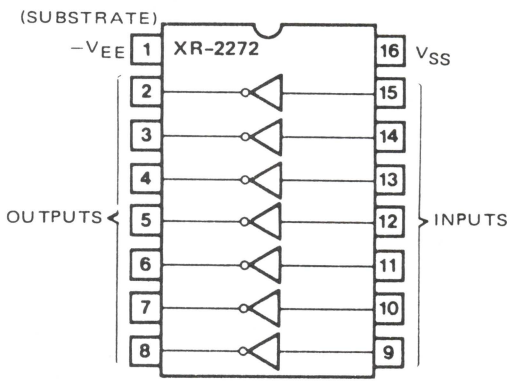
The XR-2271 fluorescent display driver requires no additional components to interface seven segment fluorescent displays to MOS Logic. The output is an emitter follower and can switch up to 50V at 20 mA. All inputs are protected to 50V and pull up resistors are integrated onto the device.

High-Voltage 7-Digit Display Driver

GENERAL DESCRIPTION

The XR-2272 is a monolithic high voltage display driver array specifically designed to drive gas-filled digit displays. The circuit is made up of seven independent digit driver sections in the same monolithic package. Its main application is to act as buffer interface between MOS outputs and the anodes of a gas discharge panel. The XR-2272 is particularly well suited to interfacing with Panaplex II type displays.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Active Low Inputs
High Breakdown Voltage
Low Power Dissipation
Complete Input-Output Isolation
On-Chip Pull-Up Resistors
Versatility for Display Interface

APPLICATIONS

Gas Discharge Display Driver
Panaplex Display Driver
MOS Logic to High-Voltage Interface

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ($-V_{EE}$)	−75V Max.
Output on Current Each Output	−20 mA Max.
Output on Current All Combined	−50 mA Max.
Positive Supply Current I_{SS}	60 mA Max.
Input Current	±3 mA Max.
Input Voltage	$-V_{EE}$, Min., V_{SS}, Max.
Package Power Dissipation, 25°C	625 mW (Plastic)
Derating above 25°C	5 mW/°C
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to 150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2272CN	Ceramic	0°C to +70°C
XR-2272CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2272 high voltage display driver features seven independent sections, each capable of switching −75 V at up to 20 mA. Each has active low inputs and monolithic pull-up resistors. The output is an emitter follower.

High-Voltage AC Plasma Display Drivers

GENERAL DESCRIPTION

The XR-2284 and the XR-2288 are high voltage display driver arrays especially designed for interfacing with ac plasma display systems. The XR-2284 contains four independent driver channels, whereas its dual version, the XR-2288, contains eight driver channels. Each driver array can be used for either the segment or the column (or digit) drive, and several arrays can be "stacked" together to drive a large number of display segments.

All four channels of the XR-2284 are driven by a common ac toggle voltage; however, the XR-2288 has two independent toggle inputs, one for each of the four channels in the IC. The XR-2284 and the XR-2288 are designed for 360 volt ac plasma systems and have minimum stand-off voltages of 90 volts. The XR-2284C and the XR-2288C are designed for 240 volt plasma systems, and have minimum stand-off voltages of 60 volts.

The circuits can operate with ac toggle frequencies up to 200 kHz, and each driver channel can sink or source 100 mA of capacitive load current. For proper operation, the substrate terminals of all drivers must be grounded through an external disconnect diode, D_X, as shown in the schematic diagram.

FEATURES

High Stand-off Voltage
- 90 V minimum for XR-2284/XR-2288
- 60 V minimum for XR-2284C/XR-2288C

Very Low AC Standby Power
- (≈25 mW/channel at 100 kHz)

Zero DC Standby Power
100 mA Output Drive Capability
TTL and CMOS Compatible Inputs
Digital or Segment Drive Capability

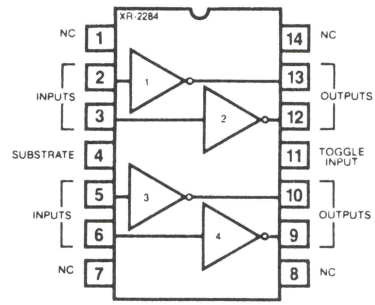
APPLICATIONS

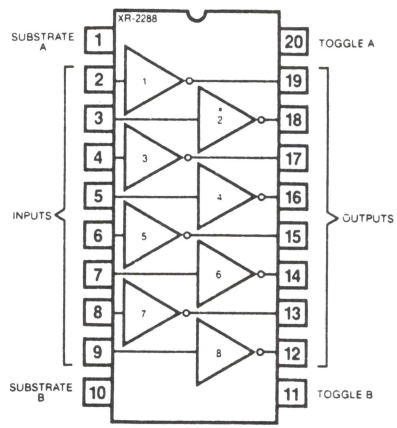
High Voltage AC Plasma Panels
High Voltage Pulsed Displays
Pulsed AC Switching

ABSOLUTE MAXIMUM RATINGS

Toggle Input Voltage	
XR-2284P/XR-2288P	±90V peak
XR-2284CP/XR-2288CP	±60B peak

FUNCTIONAL BLOCK DIAGRAMS





Power Dissipation	
XR-2284P/XR-2284CP	625 mW
XR-2288P/XR-2288CP	900 mW
Derate above +25°C	5 mW/°C
Storage Temperature	−65°C to 150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2284P	Plastic	0°C to 70°C
XR-2284CP	Plastic	0°C to 70°C
XR-2288P	Plastic	0°C to 70°C
XR-2288CP	Plastic	0°C to 70°C

Fluorescent Display Drivers

GENERAL DESCRIPTION

The XR-6118 and the XR-6128 are high-voltage display driver arrays which are designed to interface between low-level digital logic and vacuum fluorescent displays. Each circuit consists of eight independent signal channels comprised of Darlington output stages and common-emitter type inputs. All stages on the chip share common power supply and ground connections. Both device types are capable of driving digits and/or segments of fluorescent displays, and all of the eight outputs can be activated simultaneously.

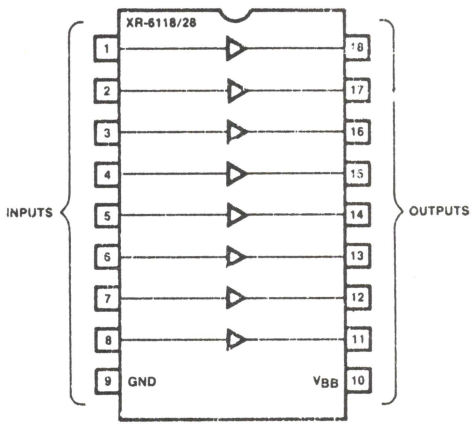
FEATURES

Direct Replacement for Sprague UDN-6118A, UDN-6128A, and UDN-6118P-2 (60V)
Digit or Segment Drive Capability
Low Input Current
Integral Output Pulldown Resistors
Low Power
High Output Breakdown Voltage

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{BB}	85V
Output Voltage, V_{OUT}	85V
Input Voltage, V_{IN}	20V
Output Current, I_{OUT}	40 mA
Power Dissipation, ($T_A \leq 25°C$)	1 W
Derate Above 25°C	8 mW/°C
Operating Temperature	0°C to +85°C
Storage Temperature	−55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-6118P	Plastic	0°C to +70°C
XR-6128P	Plastic	0°C to +70°C
XR-6118P-2	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-6118 and XR-6128 fluorscent display drivers can switch up to 85V and 40 mA. Inputs are protected to 20V. The XR-6118 is compatible with TTL, Schottky TTL, DTL and 5 Volt CMOS logic families. The XR-6128 is intended for use with PMOS or CMOS logic families operating with supply voltages of 6V to 15V. The two device types differ only in their input threshold levels (See Figure 1). With either device type, the output load is activated when the inputs are pulled toward positive supply. Output pulldown resistors are included on the die.

Section 7—Interface Circuits

High-Voltage, High-Current Darlington Transistor Arrays

GENERAL DESCRIPTION

The XR-2001/2002/2003/2004 are high-voltage, high-current Darlington transistor arrays consisting of seven silicon NPN Darlington pairs on a common monolithic substrate. All units feature open collector outputs and integral protection diodes for driving inductive loads. Peak inrush currents of up to 600 mA are allowed, which makes the arrays ideal for driving tungsten filament lamps. The outputs may be paralleled to achieve high load current capability although each driver has a maximum continuous collector current rating of 500 mA. The arrays are directly price competitive with discrete transistor alternatives.

FEATURES

Peak Inrush Current Capability of 600 mA.
Internal Protection Diodes for Driving Inductive Loads
Excellent Noise Immunity
Direct Compatibility with Most Logic Families
Opposing Pin Configuration Eases Circuit Board Layout

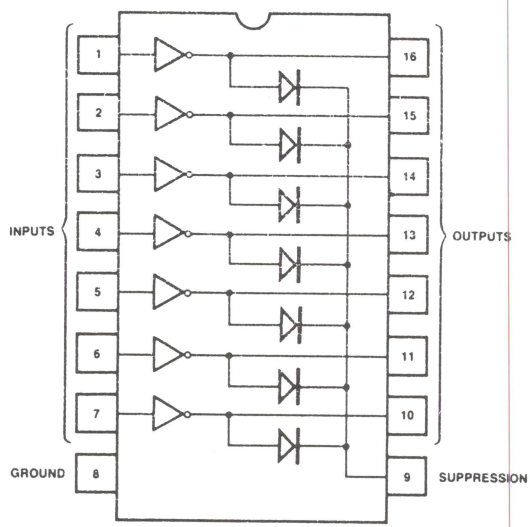
APPLICATIONS

Relay Drivers
High Current Logic Drivers
Solenoid Driver

ABSOLUTE MAXIMUM RATINGS $T_A = 25°C$

Output Voltage, V_{CE}	50V
Input Voltage, V_{IN}	30V
Continuous Collector Current, I_C (Each Driver)	500mA
Continuous Base Current, I_B (Each Driver)	25mA
Power Dissipation, P_D (Each Driver)	1.0W
(Total Package)	See graph
Derate Above 25°C	16 mW/°C
Storage Temperature Range	−55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2001CN	Ceramic	0°C to +70°C
XR-2002CN	Ceramic	0°C to +70°C
XR-2003CN	Ceramic	0°C to +70°C
XR-2004CN	Ceramic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2001 interfaces with bipolar digital logic (with external current limiting), or with CMOS or PMOS directly.

The XR-2002 was specifically designed to interface with 14V to 25V PMOS devices.

The XR-2003 permits operation directly with CMOS or TTL operating at a supply voltage of 5 volts. Interface requirements beyond the scope of standard logic buffers are easily handled by the XR-2003.

The XR-2004 requires less input current than the XR-2003 and the input voltage is less than that required by the XR-2002. The XR-2004 operates directly from PMOS or CMOS outputs using supply voltages of 6 to 15 volts.

High-Voltage, High-Current Darlington Transistor Arrays

GENERAL DESCRIPTION

The XR-2011/2012/2013/2014 are high-voltage, high-current Darlington transistor arrays consisting of seven silicon NPN Darlington pairs on a common monolithic substrate. All units feature open collector outputs and integral protection diodes for driving inductive loads. Peak inrush currents of up to 750 mA are allowed, which makes the arrays ideal for driving tungsten filament lamps. The outputs may be paralleled to achieve higher load current capability although each driver has a maximum continuous collector current rating of 600 mA. The arrays are directly price competitive with discrete transistor alternatives.

FEATURES

Peak Inrush Current Capability of 750 mA
Internal Protection Diodes for Driving Inductive Loads
Excellent Noise Immunity
Direct Compatibility with Most Logic Families
Opposing Pin Configuration Eases Circuit Board Layout

APPLICATIONS

Relay Drive
High Current Logic Driver

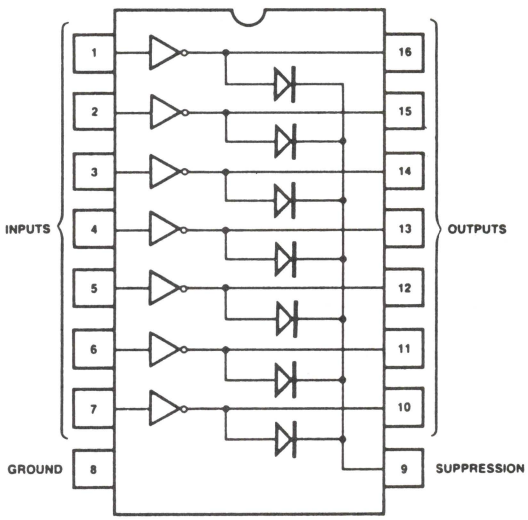
ABSOLUTE MAXIMUM RATINGS T_A = 25°C

Output Voltage, V_{CE}	50V
Input Voltage, V_{IN}	30V
Continuous Collector Current, I_C (Each Driver)	600 mA
Continuous Base Current, I_B (Each Driver)	25 mA
Power Dissipation, P_D (Each Driver)	1.0 W
(Total Package)	See graph
Derate Above 25°C	16.67 mW/°C
Storage Temperature Range	−55°C to +150°C

ORDERING INFORMATION

Part Number	Package Type	Operating Temperature
XR-2011 CN	Ceramic	0°C to +70°C
XR-2012 CN	Ceramic	0°C to +70°C
XR-2013 CN	Ceramic	0°C to +70°C
XR-2014 CN	Ceramic	0°C to +70°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-2011 device is a general purpose array to be used with bipolar digital logic (with external current limiting), or with CMOS or PMOS directly. Output pins opposite input pins facilitates circuit board layout.

The XR-2012 was specifically designed to interface with 14 to 25 volt PMOS devices. The input current is limited to a safe value by a Zener diode and resistor in series.

A 2.7 kΩ series base resistor to each Darlington pair in the XR-2013 permits operation directly with CMOS or TTL operating with a 5 volt supply. Interface requirements beyond the scope of standard logic buffers are easily handled by the XR-2013.

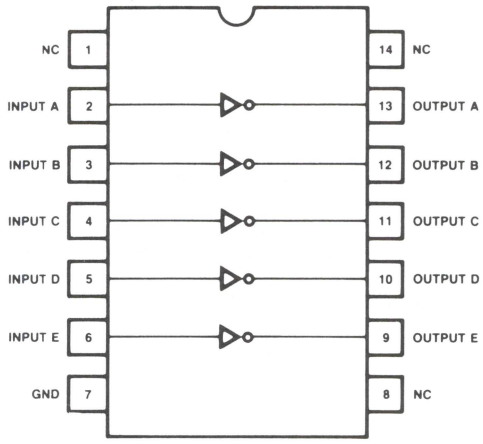
The XR-2014 requires less input current than the XR-2013 and the input voltage is less than that required by the XR-2012. The XR-2014 has a 10.5 kΩ series input resistor, permitting operation directly from PMOS or CMOS outputs using supply voltages of 6 to 15 volts.

Hammer Driver

GENERAL DESCRIPTION

The XR-2200 is an array of five Darlington transistor pairs which are capable of driving high-current loads such as solenoids, relays, and LED's. Each of the five circuits contained on the XR-2200 is capable of sinking up to 400 mA. The XR-2200 was specifically designed for use with 14 V to 25 V PMOS devices.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Output Capability of 400 mA for Each Driver
Drivers may be used in parallel for increased output drive capability.
Input is directly compatible with PMOS outputs

APPLICATIONS

Printing Calculator Hammer Driver
High Current LED Driver
Solenoid and Relay Driver
Tungsten Lamp Driver
High Current Switch

ORDERING INFORMATION

Part Number	Package Type	Operating Temperature
XR-2200 CP	Plastic	−25°C to +70°C

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	30V
Collector to Emitter Voltage	30V
Emitter to Base Voltage	5.5V
Collector Current	450 mA
Input Terminal Breakdown Voltage (plus)	30V
Input Terminal Breakdown Voltage (minus)	−0.5V
Power Dissipation	550 mW

SYSTEM DESCRIPTION

The XR-2200 hammer driver contains five Darlington connected transistor pairs, each capable of switching 30V. All five emitters are connected to a common ground (Pin 7). With a guaranteed current gain of 2000, each section of the XR-2200 can sink 400 mA.

High-Voltage, High-Current Darlington Transistor Arrays

GENERAL DESCRIPTION

The XR-2201, XR-2202, XR-2203, and XR-2204 Darlington transistor arrays are comprised of seven silicon NPN Darlington pairs on a single monolithic substrate. All units feature open-collector outputs and integral protection diodes for driving inductive loads. Peak inrush currents of up to 600 mA are allowable, making them also ideal for driving tungsten filament lamps. Although the maximum continuous collector current rating is 500mA for each driver, the outputs may be paralleled to achieve higher load current capability.

FEATURES

High Peak Current Capability—600mA
Internal Protection Diodes for Driving Inductive Loads
Directly Compatible with TTL, CMOS, PMOS, and DTL Logic Families
Exact Replacement for Sprague Types ULN-2001A, ULN-2002A, ULN-2003A, and ULN2004A

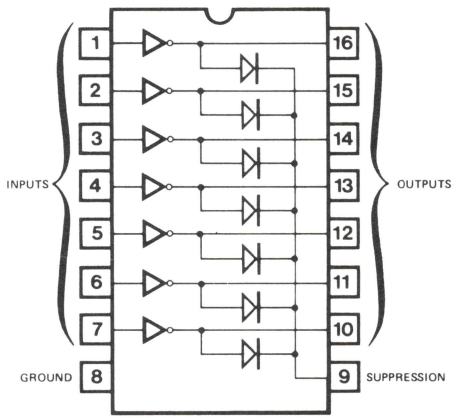
APPLICATIONS

Relay Drivers
Solenoid Drivers
High Current Inverters

ABSOLUTE MAXIMUM RATINGS T_A = 25°C

Output Voltage, V_{CE}	50V
Input Voltage, V_{IN}	30V
Emitter-Base Voltage, V_{EBO}	6V
Continuous Collector Current, I_C (Each Driver)	500mA
Continuous Base Current, I_B (Each Driver)	25mA
Power Dissipation, P_D (Each Driver)	1.0W
(Total Package)	2.0W
Derate Above 25°C	16.67 mW/°C
Storage Temperature Range	−55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2201CP	Plastic	0°C to +85°C
XR-2202CP	Plastic	0°C to +85°C
XR-2203CP	Plastic	0°C to +85°C
XR-2204CP	Plastic	0°C to +85°C

SYSTEM DESCRIPTION

The XR-2201 is compatible with most common logic forms, including PMOS, CMOS, and TTL. It requires a current-limiting resistor placed in series with the input to limit base current to less than 25mA.

The XR-2202 is designed for direct compatibility with 14V-25V PMOS devices.

The XR-2203 is compatible with TTL or CMOS operating at 5 volts. Each input has a series base resistor to limit the input current to a safe value.

The XR-2204 is designed for direct operation from CMOS or PMOS outputs utilizing supply voltages of 6 to 15V.

With all four devices, the load should be connected between the driver output and $+V_{CC}$. For protection from transient voltage spikes, Pin 9 should be connected to $+V_{CC}$.

EXAR

Section 8—Special Function Circuits

Multi-Function PLL System

GENERAL DESCRIPTION

The XR-S200 integrated circuit is a highly versatile, multipurpose circuit that contains all of the essential functions of most communication system designs on a single monolithic substrate. The function contained in the XR-S200 include: 1. a four quadrant analog multiplier, 2. a high frequency voltage controlled oscillator (VCO) and 3. a high performance operational amplifier.

The three functions can be used independently, or directly interconnected in any order to perform a large number of complex circuit functions, from phase-locked loops to the generation of complex waveforms. The XR-S200 can accommodate both analog and digital signals, over a frequency range of 0.1 Hz to 30 MHz, and operate with a wide choice of power supplies extending from ±3 volts to ±30 volts.

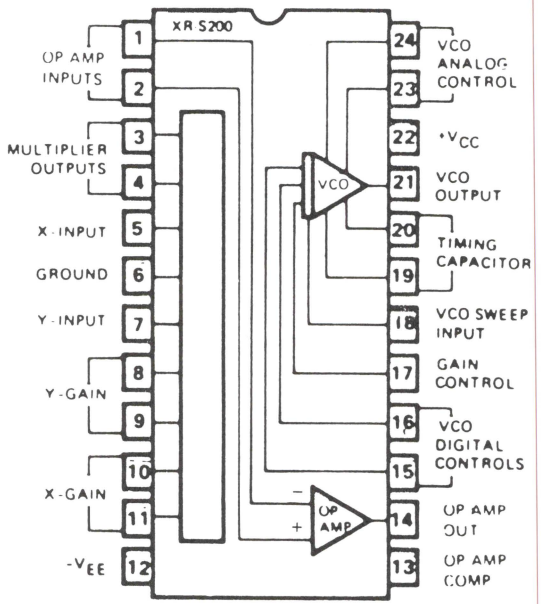
FEATURES

Wide VCO Frequency Range	0.1 Hz to 30 MHz
Wide Supply Voltage Range	±3V to ±30 V
Uncommitted Inputs and Outputs for Maximum Flexibility	
Large Input Dynamic Range	

APPLICATIONS

Phase-locked loops
FM demodulation
  Narrow and wideband FM
  Commercial FM-IF
  TV sound and SCA detection
FSK detection (MODEM)
PSK demodulation
Signal conditioning
Tracking filters
Frequency synthesis
Telemetry coding/decoding
AM detection
  Quadrature detectors
  Synchronous detectors
Linear sweep & AM generation
  Crystal controlled
  Suppressed carrier
  Double sideband
Tone generation/detection
Waveform generation
  Single/square/triangle/sawtooth
Analog multiplication

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply	30 Volts
Power Dissipation	900 mW
Derate above +25°C	5 mW/°C
Temperature	
Operating	−55°C to +125°C
Storage	−65°C to +150°C
Input Signal Level, V_S	6 V,p-p

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-S200	Ceramic	0°C to +70°C

Stereo Demodulator

GENERAL DESCRIPTION

The XR-1310 is a unique FM stereo demodulator which uses phase-locked techniques to derive the right and left audio channels from the composite signal. Using a phase-locked loop to regenerate the 38 kHz subcarrier, it requires no external L-C tanks for tuning. Alignment is accomplished with a single potentiometer.

FEATURES

Requires No Inductors
Low External Part Count
Simple, Noncritical Tuning by Single Potentiometer Adjustment
Internal Stereo/Monaural Switch with 100 mA Lamp Driving Capability
Wide Dynamic Range: 600 mV (RMS) Maximum Composite Input Signal
Wide Supply Voltage Range: 8 to 14 Volts
Excellent Channel Separation
Low Distortion
Excellent SCA Rejection

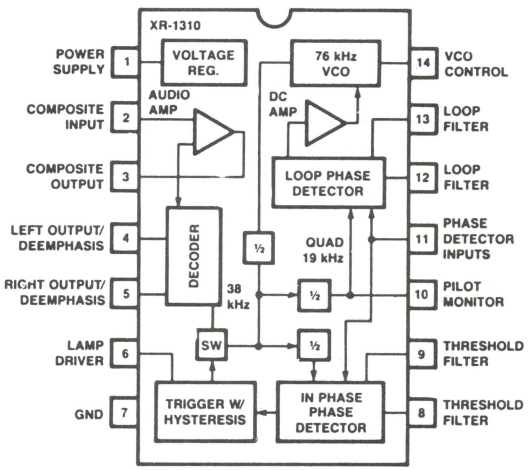
APPLICATIONS

FM Stereo Demodulation
Stereo Indicator

ABSOLUTE MAXIMUM RATINGS

(T_A = +25°C unless otherwise noted)	
Power Supply Voltage	14V
Lamp Current (nominal rating, 12 V lamp)	75 mA
Power Dissipation (package limitation)	625 mW
Derate above T_A = +25°C	5.0 mW/°C
Operating Temperature Range (Ambient)	−40 to +85°C
Storage Temperature Range	−65 to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1310CP	Plastic	−40°C to +85°C

8

SYSTEM DESCRIPTION

The XR-1310 is a complete stereo demodulator specifically designed for transforming a composite FM stereo signal into its left and right channel components.

The composite FM stereo input signal, from the receiver detector, is applied to the buffer amplifier, Pin 2. Buffered output (gain = 1) is applied to the L+R, L−R decoder.

The VCO of the PLL runs at 76 kHz, four times the 19 kHz pilot frequency. Free-running frequency is set by the parallel RC circuit on Pin 14. The VCO output drives a controlled switch which allows demodulation. When the PLL is locked, the lamp driver open collector output (Pin 6) can sink up to 100 mA.

Left and right channel outputs are taken from Pins 4 and 5 respectively. De-emphasis is performed by the RC circuit here; slightly higher gain is possible by increasing the resistor size, but the RC product should remain constant.

Monolithic Compandor

GENERAL DESCRIPTION

The XR-2216 is a monolithic audio frequency compandor designed to compress or expand the dynamic range of speech or other analog signals transmitted through telecommunication systems. The monolithic circuit can be connected as either a compressor or an expander, the choice being determined by the external circuitry.

FEATURES

Functions as either a Compressor or an Expander
Wide Dynamic Range: 60 dB
Wide Supply Range: 6 to 20 Volts
Excellent Transfer Function Tracking
Low Power Supply Drain
Controlled Attack and Release Times
Low Noise and Low Distortion

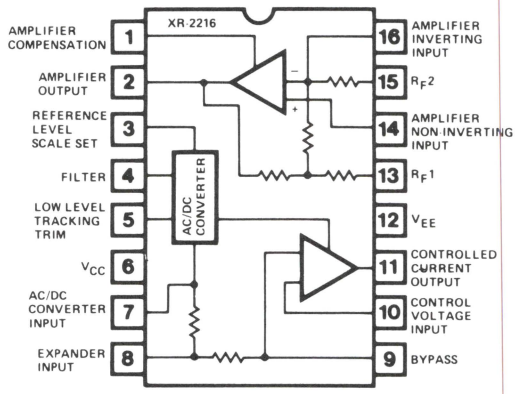
APPLICATIONS

Telephone Trunk—Line Compandor
Speech/Data Compression and Expansion
Telecommunication Systems
Mobile Communications
Model Data Processing

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	20V
Power Dissipation	
Ceramic Package	750 mW
Derate above +25°C	6 mW/°C
Plastic Package	625 mW
Derate above +25°C	5 mW/°C
Storage Temperature	−60°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package (16 Pin DIP)	Operating Temperature
XR-2216CN	Ceramic	−40°C to +60°C
XR-2216CP	Plastic	−40°C to +60°C

SYSTEM DESCRIPTION

The XR-2216 is comprised of four basic blocks: (1) an internal voltage reference; (2) an AC/DC converter which converts AC signal input to a DC current level; (3) an impedance converter whose impedance level is a function of a DC control signal; and (4) a high gain operational amplifier.

The XR-2216 is designed to accommodate a wide range of system configurations. It can be operated with positive or negative single supply systems, or dual power supplies over a power supply range of 6 volts to 20 volts.

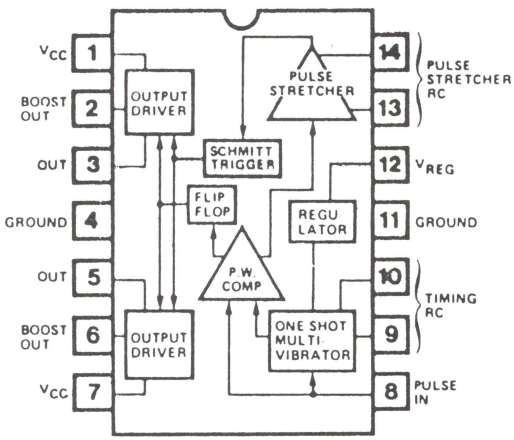
Pulse-Proportional Servo Circuit

GENERAL DESCRIPTION

The XR-2264 and 2265 are Monolithic circuits designed for use in pulse-proportional servo systems. They have been specifically designed for Radio Control applications. These devices are capable of controlling positions in direct proportion to the width of input pulses. The 2264 can interface directly with servo motors requiring up to 350mA of drive current. The 2265 with open collector outputs can drive relays, optical couplers and triacs, directly. Both the 2264 and 2265 can drive external PNP transistors for applications requiring high current output drive.

The XR-2264 or 2265, combined with a servo motor and a feedback potentiometer form a closed-loop system. These devices have internal one-shot multivibrators. The pulse width of this one-shot is controlled by the servo potentiometer. When an input pulse is applied, the motor is turned "on" in the direction necessary to make the internal one-shot pulse width equal to the incoming pulse width. Because the transfer characteristics of the XR-2264 and 2265 can be controlled by the selection of external components, it can be used in many industrial and radio controlled servo-system applications.

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2264 CP XR-2265 CP	Plastic Dual-In-Line	−10°C to +50°C

FEATURES

Wide Supply Voltage Range (3.0V to 6.0V)
Bi-directional Operation with Single Supply
Separately-Adjustable Dead Band and Pulse Stretching
2264 - 350mA Source and Sink on chip.
500mA with External PNP
2265 - 500mA Sink Capability on chip.
500mA Sink or Source Capability with external PNP

APPLICATIONS

Remote Control Toys
Robotics Applications

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	6.5V
Power Dissipation	550 mW
Storage Temperature Range	−65°C to +150°C

SYSTEM DESCRIPTION

Figure 3 shows the circuit connection diagram for the XR-2264. The external component values shown are selected for a pulse width range of 1 to 2 msec, a frame time of 12.5 msec, and a dead band* that is suitable for use with small radio-controlled servos. However, with a proper choice of external components, the characteristics of these devices can be adapted to provide optimum performance for a broad range of hobby and industrial servo control applications.

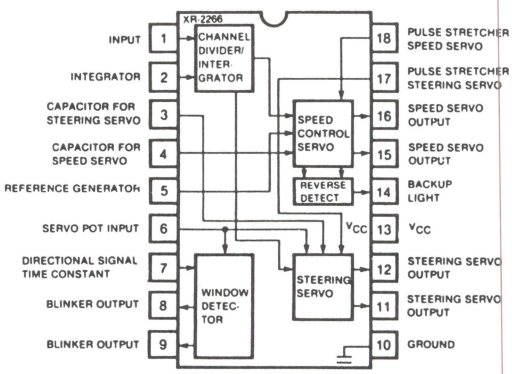
The shaft of potentiometer R_2 is connected to the servo output shaft; the voltage on the wiper provides positional feedback to the one-shot multivibrator of the XR-2264 or 2265. The one-shot pulse width range is set by the product of R_1 and C_1; R_1 should be kept in the range of 8KΩ to 16KΩ. For operation over a range of pulse widths

Monolithic Servo Controller

GENERAL DESCRIPTION

The XR-2266 is a monolithic servo controller specifically designed for radio controlled model cars. The device is capable of controlling speed in forward or reverse, direction of turn, backup lights, and turn signals with programmable flash rate. Supply voltage may range from 3.5V to 9V.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Internal Channel Divider
Internal Steering Servo with Direct Drive for Servomotor and Turn Signal Indicators
Directional Signal Time Constant Externally Settable
Variable Speed Control with Direct Drive for Backup Lights
Wide Supply Range (3.5 - 8.0 volts)
Steering and Speed Servos Independently Programmed

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2266	Plastic	0°C to +70°C

APPLICATIONS

Radio Controlled Cars

SYSTEM DESCRIPTION

The XR-2266 is a monolithic servo controller system specifically designed for radio-controlled model cars. The integrated circuit is a self-contained system made up of two servo controller channels: one controls the direction and speed of travel, the other provides the steering function. The circuit contains an internal channel separator section which automatically steers the incoming control signal to the appropriate servo controller channel.

The entire servo controller system is available in an 18-Pin dual-in-line package, with terminals provided for accessory controls such as turn indicator signals and backup lights. The entire system is fabricated on a monolithic chip, using low-power integrated injection logic (I^2L) technology along with precision analog circuitry. It operates with supply voltages in the range of 3.5 volts to 8 volts.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	9V
Power Dissipation	1100 mW
Derate above T_A = 25°C	6 mW/°C
Storage Temperature Range	−65°C to +150°C

Frequency-to-Voltage Converter

GENERAL DESCRIPTION

The XR-2917 Frequency-to-Voltage Converter is a high accuracy converter consisting of input comparator with 40 mV hysteresis, charge pump, Zener regulator, and output op amp and transistor. Designed for tachometer and motor control applications, it features excellent linearity and high current output.

Output voltage is a simple function of the Zener regulator voltage (V_Z), a resistor (R_1) and capacitor (C_1) which are connected to the charge pump, and the input frequency (f_{in}). Ripple reduction is implemented by addition of one capacitor (C_2) which is used to achieve frequency doubling. The output transistor can swing to ground, sink a load current of 40 mA, and offers a maximum V_{CE} of 28 V. Stable and accurate frequency to voltage or current conversion is ensured by the on-chip Zener regulator which is connected across the power leads. The Zener may be used with any supply voltage (up to 28 V) when a suitable resistor is connected between the Zener and the supply.

The XR-2917 may be operated with a ground referenced input or differential tachometer input with uncommitted op amp inputs. The ground referenced configuration is most basic, allowing the realization of single speed, frequency switching, and buffered frequency-to-voltage or current conversion applications. Differential input configurations allow the tachometer to be floated, while uncommitted op amp inputs free the op amp for implementation of active filter conditioning of the tachometer output.

The XR-2917, available in a 14 Pin DIP, operates from a single power supply of up to 28 V.

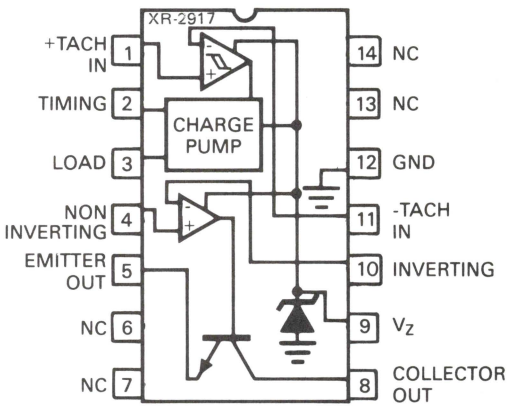
FEATURES

Design Simplicity: $V_{OUT} = f_{in} \times V_Z \times R_1 \times C_1$
Frequency Doubling to Decrease Output Ripple
On-Chip Zener for Functional Stability
Excellent Linearity
Floating Output Drive Transistor Provides 40 mA Source or Sink
Ground Referenced Tachometer Input Which Interfaces Directly with Variable Reluctance Magnetic Pickups.

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2917CN	Ceramic	0°C to +70°C
XR-2917CP	Plastic	0°C to +70°C

FUNCTIONAL BLOCK DIAGRAM



SYSTEM DESCRIPTION

The XR-2917 converts an input frequency to a proportional output voltage. Differential inputs provide hysteresis for excellent noise rejection and the capability of setting the comparator's input switching level. Inputs should not be taken below ground without some lead resistance.

The output of the comparator is fed into a charge pump where current is pumped through a timing capacitor (C_1). This same current is mirrored in the load resistor (R_1) where a filter capacitor (C_2) may be used to integrate current pulses and provide a proportional voltage across the load resistor. The result is a voltage across the load resistor which is a function of the supply voltage, input frequency, timing capacitor, and load resistor:

$$V_{R_1} = V_Z \times f_{in} \times C_1 \times R_1$$

The size of the integrating capacitor (C_2) is dependent only on the requirements of response time and output ripple.

The output op amp and transistor are then used to buffer the output drive capability of the part. Thus, the final conversion equation is:

$$V_O = V_Z \times f_{in} \times C_1 \times R_1 \times K$$

where K is the gain provided by the tachometer section, and is typically unity.

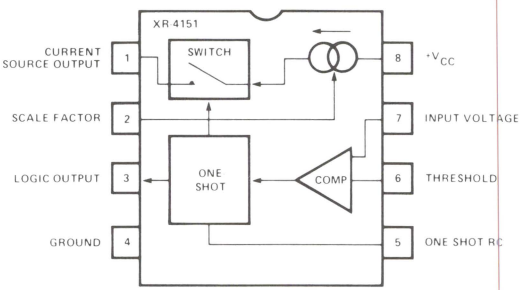
8

Voltage-to-Frequency Converter

GENERAL DESCRIPTION

The XR-4151 is a device designed to provide a simple, low-cost method for converting a DC voltage into a proportional pulse repetition frequency. It is also capable of converting an input frequency into a proportional output voltage. The XR-4151 is useful in a wide range of applications including A/D and D/A conversion and data transmission.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Single Supply Operation (+8V to +22V)
Pulse Output Compatible With All Logic Forms
Programmable Scale Factor (K)
Linearity ±0.05% Typical–Precision Mode
Temperature Stability ±100% ppm/°C Typical
High Noise Rejection
Inherent Monotonicity
Easily Transmittable Output
Simple Full Scale Trim
Single-Ended Input, Referenced to Ground
Also Provides Frequency-to-Voltage Conversion
Direct Replacement for RC/RV/RM-4151

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-4151P	Plastic	−40°C to +85°C
XR-4151CP	Plastic	0°C to +70°C

APPLICATIONS

Voltage-to-Frequency Conversion
A/D and D/A Conversion
Data Transmission
Frequency-to-Voltage Conversion
Transducer Interface
System Isolation

ABSOLUTE MAXIMUM RATINGS

Power Supply	22V
Output Sink Current	20 mA
Internal Power Dissipation	500 mW
Input Voltage	−0.2V to +V_{CC}
Output Short Circuit to Ground	Continuous

SYSTEM DESCRIPTION

The XR-4151 is a precision voltage to frequency convertor featuring 0.05% conversion linearity, high noise rejection, monotonicity, and single supply operation from 8V to 22V. An RC network on Pin 5 sets the maximum full scale frequency. Input voltage on Pin 7 is compared with the voltage on Pin 6 (which is generally controlled by the current source output, Pin 1). Frequency output is proportioned to the voltage on Pin 7. The current source is controlled by the resistance on Pin 2 (nominally 14kΩ) with I = 1.9 V/R. The output is an open collector at Pin 3.

8-Bit Microprocessor Compatible Digital-To-Analog Converter

GENERAL DESCRIPTION

The XR-9201 is a monolithic 8-Bit μP compatible digital-to-analog converter with differential current outputs. It contains an internal data latch, making it suitable for interfacing with microprocessors. The chip contains a stable voltage reference (2.0 V Nominal) which is externally adjustable and can be used as a reference for other D/A and A/D converters.

The XR-9201 features non-linearity of ± ½ LSB maximum (±.19% of full scale current). The internal voltage reference maintains a temperature coefficient of 50 ppm/°C.

FEATURES

8-Bit Resolution	
Input Data Latches	
Internal Voltage Reference	
Microprocessor Compatible	
Non Linearity	± ½ LSB Maximum
Full Scale Current Stability	±50 ppm/°C
Reference Voltage Stability	±50 ppm/°C
Differential Current Outputs	
TTL Compatible	

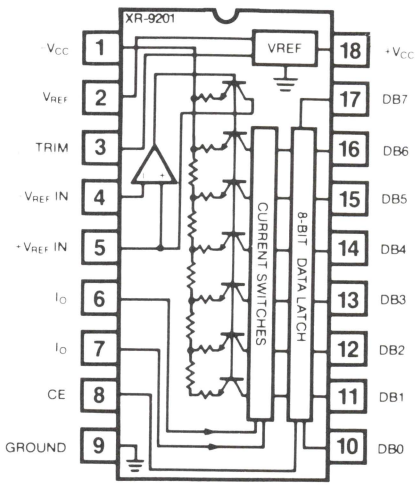
APPLICATIONS

Bipolar and Unipolar D/A Conversion
A/D Conversion
Test Equipment
Measuring Instruments
Programmable Current Source
Programmable Voltage Source

ABSOLUTE MAXIMUM RATINGS

$+V_{CC}$ Positive Supply Voltage	+6V
$-V_{CC}$ Negative Supply Voltage	−8.5V
Logic Input Voltages	0 to +6V
Power Dissipation	500 mW
Derate Above 25°C	5 mW/°C
Storage Temperature	−55°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-9201 CP	Plastic	0° to +70°C

SYSTEM DESCRIPTION

To convert the output currents of the digital-to-analog converter to a voltage, an operational amplifier can be used as shown in Figure 12.

Care must be taken in selecting an operational amplifier to be used in D/A conversion. For accurate conversion, the operational amplifier should have low input offset voltage, low input bias and offset currents, and fast settling times. Input offset voltage contributes a DC error on the output and should be properly nulled. Input bias current contributes to the D/A converter current flowing through the feedback resistor, R_{FB}, and also causes a DC error on the output voltage. This error can be reduced by the addition of a resistor equal in value to R_{FB} from the noninverting input to ground. Settling time is important because it rules how fast the output reaches its prescribed voltage level. The OP-01 is suitable for D/A converter applications producing negligible errors.

Dual Operational Transconductance Amplifier

GENERAL DESCRIPTION

The XR-13600 is a dual operational transconductance (Norton) amplifier with predistortion diodes and non-committed Darlington buffer outputs.

The device is especially suitable for electronically controllable gain amplifiers, controlled frequency filters, an other applications requiring current or voltage adjustments.

FEATURES

Direct Replacement for LM-13600 and LM-13600 A
Transconductance Adjustable Over 4 Decades
Excellent Transconductance-Control Linearity
Uncommitted Darlington Output Buffers
On-Chip Predistortion Diodes
Excellent Matching Between Amplifiers
Wide Supply Range: ±2V to ±18V

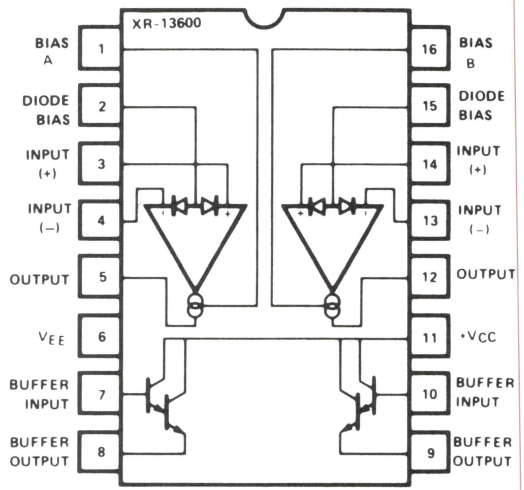
APPLICATIONS

Current-Controlled Amplifiers
Current-Controlled Impedances
Current-Controlled Filters
Current-Controlled Oscillators
Multipliers/Attenuators
Sample and Hold Circuits
Electronic Music Synthesis

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (See Note 1)	±22 V
Power Dissipation (T_A = 25°C, see Note 2)	625 mW
Derate Above 25°C	5 mW/°C
DC Input Voltage	$+V_{CC}$ to $-V_{EE}$
Differential Input Voltage	±5 V
Diode Bias Current (I_D)	2 mA
Amplifier Bias Current (I_B)	2 mA
Output Short Circuit Duration	Indefinite
Buffer Output Current (Note 3)	20 mA
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-13600AP	Plastic	0°C to + 70°C
XR-13600CP	Plastic	0°C to + 70°C

SYSTEM DESCRIPTION

The XR-13600 consists of two programmable transconductance amplifiers with high input impedance and push-pull outputs. The two amplifiers share common supplies but otherwise operate independently. Each amplifier's transconductance is directly proportional to its applied bias current. To improve signal-to-noise performance, predistortion diodes are included on the inputs; the use of these diodes results in a 10 dB improvement referenced to 0.5% THD. Independent Darlington emitter followers are included to buffer the outputs.

EXAR

Section 9—User Specific Linear ICs—Semi-Custom/Full Custom

SEMI-CUSTOM DESIGN CONCEPT

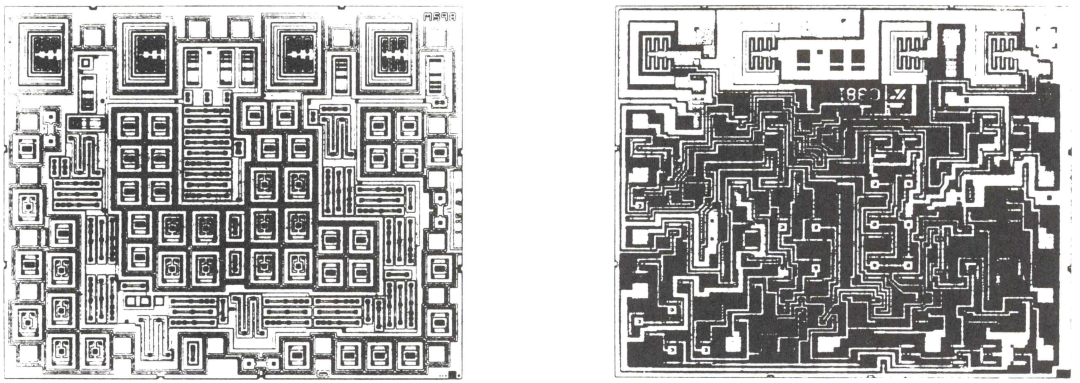
Traditionally, the development of custom IC's has been a long and costly undertaking. The development time would normally run in excess of one year, design changes are slow and costly, and it may take a long time to get from the prototype stage to full production. Because of these difficulties, the use of custom IC's could be economically justified only when a very large quantity of circuits, i.e., several hundred-thousand units, were required during the life of the end product. In the past, these drawbacks have severely limited the use of custom monolithic IC's.

The semi-custom design concept, pioneered by Exar, now overcomes this traditional problem. Exar makes this possible by stocking wafers that are completely fabricated except for the final process step of device interconnection which metalizes all selected components together in the required circuit configuration. This enables an engineer to design a metal mask based on his circuit which will interconnect the uncommitted components on the prefabricated wafers, and thus convert them into customized chips corresponding to the customer's design. This unique method of IC design and development allows one to develop an almost unlimited variety of custom linear or digital integrated circuits at very substantial cost savings.

The semi-custom program is intended for those customers seeking cost effective methods of reducing component count and board size in order to compete more effectively in a changing marketplace. The program allows a customized monolithic IC to be developed with a turnaround time of several weeks, at approximately 10% to 20% of the development costs for tooling associated with the conventional full custom designs. The semi-custom design concept is an interactive or cooperative development effort between Exar and the customer. In most cases, the cost and development time for the program can be reduced even further if the customer does the design and breadboarding of his own semi-custom IC, using Exar Design Kits, instruction manuals and layout sheets.

The semi-custom design approach is based on a number of standardized IC chips with fixed component locations. These standardized IC chips, called Master-Chips, contain a large number of undedicated active and passive components (i.e., transistors, resistors, logic gates, etc.). These integrated components can be interconnected in thousands of different ways with a customizing interconnection pattern. Each different metal interconnection pattern creates a new custom IC. The figures below show the magnified photograph of a Master-Chip, both in its prefabricated form and after its customization with a special interconnection pattern. This method is called semi-custom rather than full custom, since only the last layer of tooling is changed to customize an IC chip, and rest of the layers are standard. As a result, the development phase is very short, far less expensive and risk free, compared to conventional full or dedicated custom IC's. Similarly, if a design change or iteration is necessary, it can be readily accommodated within a matter of weeks by simply generating a new or modified interconnection pattern.

Exar offers a wide choice of Master-Chips for linear and digital semi-custom design. Presently, Master-Chips are available in linear bipolar, linear compatible I^2L and CMOS technologies. Additional chips are under development for a variety of special applications. The details of each of the presently available chips are discussed in the later section of this book.



Magnified Photograph of a Linear Master-Chip Before and After Customizing

DESIGN KITS

Exar offers three Design Kits: One for linear bipolar, one for I^2L and one for CMOS. Since the general approach to semi-custom design is the same as that for full custom, these design kits are valuable tools for both full custom and semi-custom design work. This is especially true in the case of linear design. Each of these kits contain a comprehensive design manual, a set of semi-custom layout sheets and a P.C. board, IC sockets and other hardware for building your breadboard. The only active components in these kits, that are meant for use in breadboarding, are the transistor arrays found in the linear bipolar and I^2L design kits. The logic blocks found in the I^2L design kit is meant to be used for process evaluation. Digital breadboarding can be done using the appropriate logic family such as 74LXX, 74CXX or 4XXX. The kits are designed so that an engineer, armed only with a background in discrete design, a calculator and a pencil, can design his own customized integrated circuit. The technical material is presented in a straight forward, no-nonsense format with lots of illustrative figures and all of the pertinent equations.

After the circuit is designed, and before it is breadboarded, it is recommended that the customer send Exar a schematic and a circuit description for an engineering evaluation. Normally, there is no charge for such an evaluation. Exar has successfully completed well over 850 custom design programs and our experience can provide valuable guidelines. Exar's Applications Engineering department is ready and able to help our semi-custom design program customers in both the breadboard and layout stage. We can provide immediate answers to your circuit design or testing questions, and speed your custom design on its way.

YOUR FIRST STEP

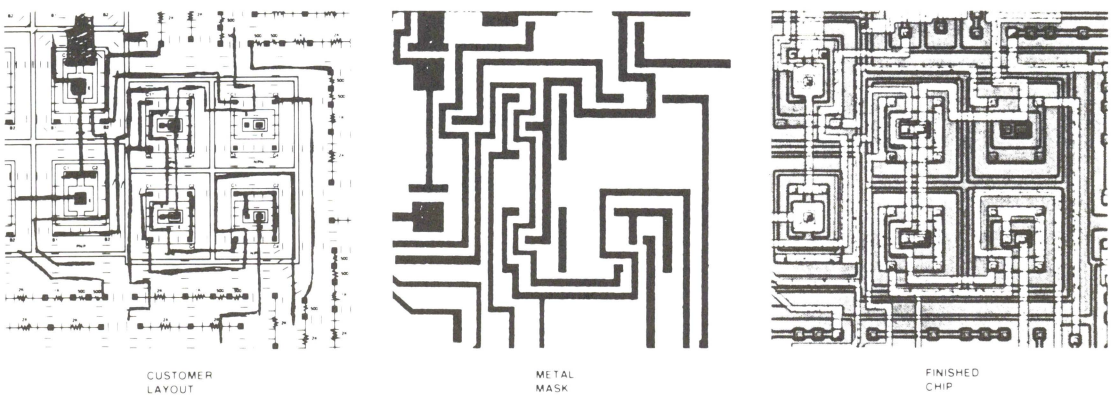
Your very first step, at the start of a semi-custom program, should be to contact Exar for a preliminary analysis and discussion of your needs. This can be done even while the program is still at the thought stage. This initial review by Exar is performed at no cost to the customer and is essential to the success of the program. It avoids any possible design pitfalls or misunderstandings. This early interaction also allows you to find out some of the options or variations available in Exar's semi-custom programs and choose the one which is best suited to your needs.

The following is required by Exar's technical staff to provide you with an accurate feasibility study of your project. and a budgetary estimate of the development costs, timetables and production pricing.

- A block diagram of circuit function and input/output interface requirements.
- A circuit schematic or logic diagram of your circuit.
- Preliminary or objective performance specifications and limits on critical circuit parameters (also possible tradeoffs which may be allowed).
- Test specifications
- Packaging requirements.
- Production quantity requirements.
- Desired development and production timetables.
- An indication of how much of the breadboarding, layout, etc., can be done by you, the customer, using Exar's Design Kits or standard logic blocks (74LXX, 74CXX or 4XXX).

Once the above data package is submitted to Exar, we would review it and respond to you within a few days.

Normally, the test system development effort is initiated in parallel with chip development. Exar has a complete computer controlled IC test facility and offers complete IC testing capability for production units.



Steps of Semi-Custom Design

FREQUENTLY ASKED QUESTIONS AND THEIR ANSWERS

Based on our long experience with Exar's semi-custom Master-Chips, we have compiled a comprehensive glossary of the most often asked questions concerning the program. The following is a list of these questions and their answers.

WHAT IS THE COST OF THE BASIC PROGRAM?

The cost of the semi-custom development program depends on how much of the design and layout is done by the customer. In general, the basic semi-custom program is where the customer does the design, breadboard evaluation and pencil layout on the Master-Chip worksheet; and Exar does only the IC tooling and prototype fabrication. This is the most economical and cost effective approach.

For bipolar semi-custom designs, the development cost of the basic program is in the range of $2,000 to $8,000, starting with an accurate layout supplied by the customer. The above prices also include the cost of 50 monolithic prototypes delivered at the completion of the program. Additional prototypes are available at a nominal cost, in minimum lots of 200 units.

In the case of I^2L or CMOS semi-custom designs, the basic development program costs are in the range of $4,200 to $8,500, depending on the layout complexity and the particular Master-Chip used. This development cost also includes 25 monolithic prototypes. Additional prototypes are available at a nominal cost, in minimum lots of 200 units each.

WHAT IS THE DEVELOPMENT TIME?

Typical development time for the basic bipolar semi-custom program is four to six weeks, starting with the customer's pencil layout and ending with the monolithic prototypes. If Exar is required to do the IC layout or breadboard evaluation, several additional weeks may be required to complete the development program.

In the case of I^2L or CMOS semi-custom development programs, the typical development time is eight to ten weeks, starting with the pencil layout of the Master-Chip worksheet. The I^2L semi-custom program takes slightly longer than bipolar or CMOS because it requires three layers of custom tooling, rather than one, to customize a prefabricated Master-Chip.

WHAT IF ADDITIONAL DESIGN CYCLES ARE NEEDED?

If the customer desires to modify the design or layout after evaluation of the initial prototypes, a new design iteration cycle can be completed within five weeks for the bipolar and CMOS designs, and within eight to ten weeks for the I^2L designs. Cost for this iteration is dependent on the complexity of modification.

WHAT ABOUT PRODUCTION PRICING?

The production pricing of monolithic IC's depends upon a number of important factors such as:

a) Master-Chip type.

b) Circuit complexity (i.e., yield).

c) Device performance and test requirements.

d) Special environmental screening requirements (burn-in, hermeticity tests, etc.).

e) Package type required.

In the case of a custom IC, it is impossible to anticipate the impact of these factors without detailed knowledge about the circuit and its application. Each custom IC, by definition, has some unique requirement or feature associated with it. After reviewing your specific needs, particularly with regard to the circuit performance and quality requirements, Exar can provide you with a detailed proposal outlining the development costs and production pricing for your particular circuit.

WHAT ABOUT THE TESTING OF SEMI-CUSTOM IC's?

Exar will develop test software and fixtures to provide fully tested production IC's. All production devices receive 100% electrical test and screening to a mutually agreed upon device specification. In addition to the complete electrical testing, all of the production devices are screened by Exar's Quality Assurance department to assure compliance with the agreed upon Acceptable Quality Level (AQL) standards.

Exar can perform two basic types of tests for production IC's: (1) parametric testing which measures a specific parameter value (normally current or voltage) and compares it against pre-established limits; (2) functional testing which applies a series of operating conditions and compares the circuit under test with a known good device. These two types of tests can be performed both as steady state (dc) or dynamic (ac) measurements.

ECONOMICS OF SEMI-CUSTOM DESIGN

In developing either linear or digital custom circuits, one is always confronted with the following key question: for a given product type and production requirement, is it cheaper to develop a semi-custom or full custom IC? Since the functional requirements of each custom IC program vary greatly, there is no general answer to the above question. However, based on Exar's long experience in both full and semi-custom IC design and depending on the overall production requirements, it is possible to establish some sound economic guidelines for choosing the most cost effective approach.

COST FACTORS INVOLVED

Any custom IC development, whether full or semi-custom, involves similar types of cost factors. These are:

1. Non recurring engineering (NRE) or development costs.

2. Cost or unit price of the product in production quantities.

In the case of monolithic IC's, particularly those which have relatively limited production volume, the development costs may be a significant factor in the cost of the end product. Therefore, when discussing the economics of custom IC's for medium to low production quantities, it is best to consider the cost tradeoffs in terms of the amortized unit price of the IC at a given production volume. This amortized unit price is defined as the actual cost of each unit including its share of the development cost. As an example, a full custom IC may cost $50,000 to develop and may be priced at $2.90 each at a 50,000 piece total production level. Then, its true amortized unit price including development costs will be $2.90 plus $1.00, or $3.90. Similarly, an equivalent semi-custom IC may cost $5,000 to develop and be priced at $3.20 each, at the same 50,000 production level. Then, its amortized per unit price will be $3.30, or approximately 20% cheaper than a full custom.

The figure below gives a comparative graph of the amortized unit price for a typical full custom design, along with the equivalent in semi-custom form for various production quantities. For comparison purposes, the relative ratio of the amortized unit price is plotted along the vertical axis. If this ratio is greater than 1.0 then the semi-custom method is the more cost effective solution.

NO TWO IC's ARE THE SAME

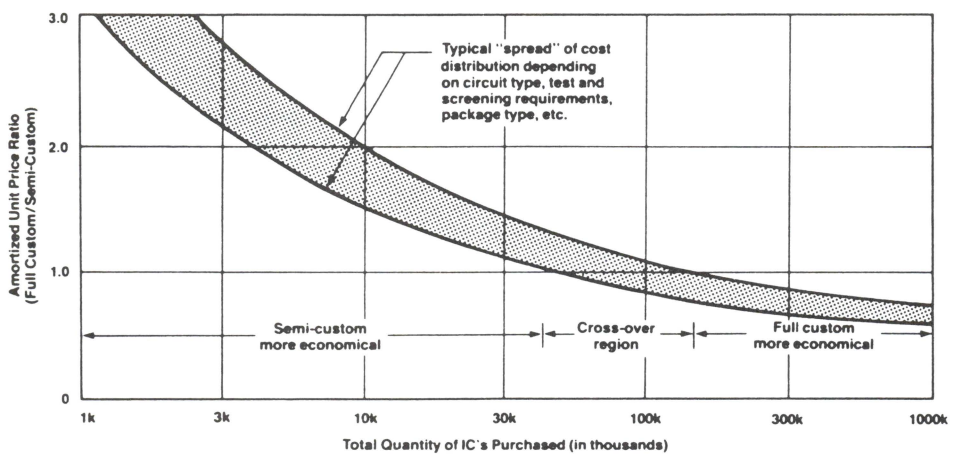
By definition, each custom IC type is unique. Therefore, the cost comparison curve given below is shown as a spread rather than a single line. This is because, in addition to the production quantity, the cost of monolithic IC's also depends on the circuit complexity, special test requirements and the IC package type.

The key information contained in the relative cost vs. quantity figure can be summarized as follows:

1. For a total production requirement of 50,000 pieces or less, the semi-custom approach is definitely the most economical.

2. For a production requirement of 200,000 pieces or more, the full custom design is more cost effective.

3. For production quantity requirements in the 50,000 to 200,000 piece range, the crossover point for the most economical approach will depend strongly on the specifics of a particular IC function; i.e., its special test, environmental screening, and package requirements.



TYPICAL COST VS QUANTITY COMPARISON OF FULL CUSTOM AND SEMI-CUSTOM DESIGNS

CONVERTING SEMI-CUSTOM TO FULL CUSTOM

Exar can offer you the combined advantages of semi-custom and full custom design programs. This is because Exar has a complete semiconductor manufacturing facilities. This unique capability allows Exar to state a custom development program using a combination of semi-custom Master-Chips during the initial phases of a customer's product, taking full advantage of the low tooling cost and short development cycle. As the product matures and its market expands (resulting in higher volume production run rates) Exar can convert the multiple semi-custom chip approach into a single custom IC, thus achieving a cost reduction and in many cases a performance improvement. The significant advantage of this type of program is that the risk associated with a custom development is greatly reduced. The IC design approach has been proven, production "bugs" are out of the product and your production line continues to flow during the full custom chip development. Once the custom chip is completely characterized and found acceptable, the semi-custom IC system in your product can be phased out while the full custom IC is being phased in.

SEMI- AND FULL CUSTOM COMBINATION: THE TWO-STEP DEVELOPMENT

In many custom development programs one is faced with very short development times and a rapid transfer into high volume production. Such a requirement does not leave room for lengthy development and design change or iteration cycles associated with conventional full custom IC design.

Exar combines full and semi-custom design capabilities, and a complete wafer fabrication facility under one roof, therefore, providing a unique solution to this problem; initially developing the prototypes in a semi-custom form, and then converting them to full custom.

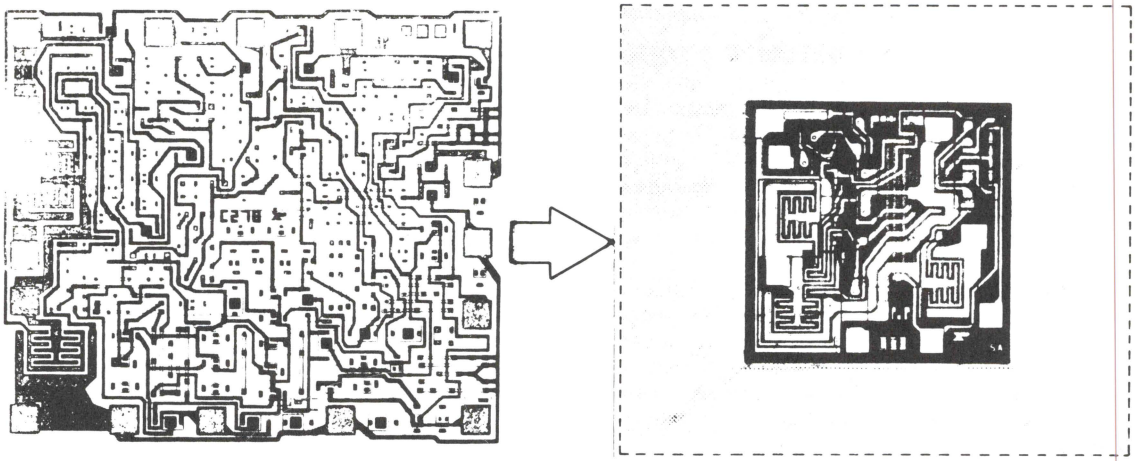
In this manner, the customer has the best of both worlds with the combination of these two technologies. The quick turnaround advantage of semi-custom Master-Chips provide prototypes and initial production units, while the subsequent full custom design provides cost savings at high volume production. During this transition, the customer is assured of a continuous flow of product through its production line.

In such a two-step development, the semi-custom prototypes often serve as a monolithic breadboard to optimize and debug the final design. This allows design iterations or changes to be made quickly and inexpensively. In fact, the only difference between the semi-custom and full custom chip is the actual size of the silicon chip.

Once the design is satisfactory, conversion of a semi-custom to a full custom chip is very straight forward and relatively risk free. We simply remove the unused electrical components from the chip to reduce the chip size and pass the resulting cost savings on to you in the form of a reduced unit price.

The two-step development capability; i.e., start as semi-custom and finish as full custom, is a very powerful design technique. It avoids the risks associated with a conventional black box type of custom design where one does not know until the very last day of development whether the circuit works or if it can be manufactured.

The two-step program is faster and less expensive than the conventional full custom development, since it avoids costly and lengthy design iteration or modification cycles for a full custom IC. In addition, it gives the customer a very high degree of assurance that the final full custom unit will work the first time.



SEMI-CUSTOM DESIGN AND ITS FULL CUSTOM EQUIVALENT

ADVANTAGES OF SEMICUSTOM DESIGN

Significant lower costs	Hybrids and discretes are quite expensive as compared to semicustom ICs. Less inventory cost also.
Higher reliability	Than hybrids and discretes. Because one semicustom IC replaces many components.
Quick turnaround	Semicustom protos are delivered in less than seven (7) weeks.
Lower development cost	Less than half the full custom cost.
Iterations	Are quick and less expensive than full custom because only one mask needs to be changed.
Reduced real estate & power	Because one IC is replacing many components. Therefore, your PC board may shrink 60-80%. Consequently, less power too.
Quick production ramp up	Need 200,000 units in less than 12 weeks? Exar can deliver using its semicustom **Master-Chip**® approach.
Product security	Semicustom IC is specifically designed for you; it is not available to your competitors as an off-the-shelf ITEM.
Reduced power, inventory cost, and production cost	Because one custom IC replaces many discrete components.

FULL CUSTOM DEVELOPMENT

Exar offers a complete design and production capability for full custom IC development. This provides an excellent complement to Exar's unique semi-custom capability. Exar's full custom IC development and production capabilities offer complete flexibility to meet changing customer needs or design problems. We can develop a complete custom IC starting from your black box specifications, or reduce your working breadboard prototype to a monolithic chip. Alternately, if you have the facilities and resources to do the IC design and layout, Exar will provide you with the device characteristics and IC layout rules for the particular process suitable to your design and review your IC layout for you. Then, Exar can generate the IC tooling and fabricate your IC prototypes.

YOUR FIRST STEP FOR FULL CUSTOM DESIGN

The following technical data package is required in order for Exar to provide you with a quotation for your full custom development program:

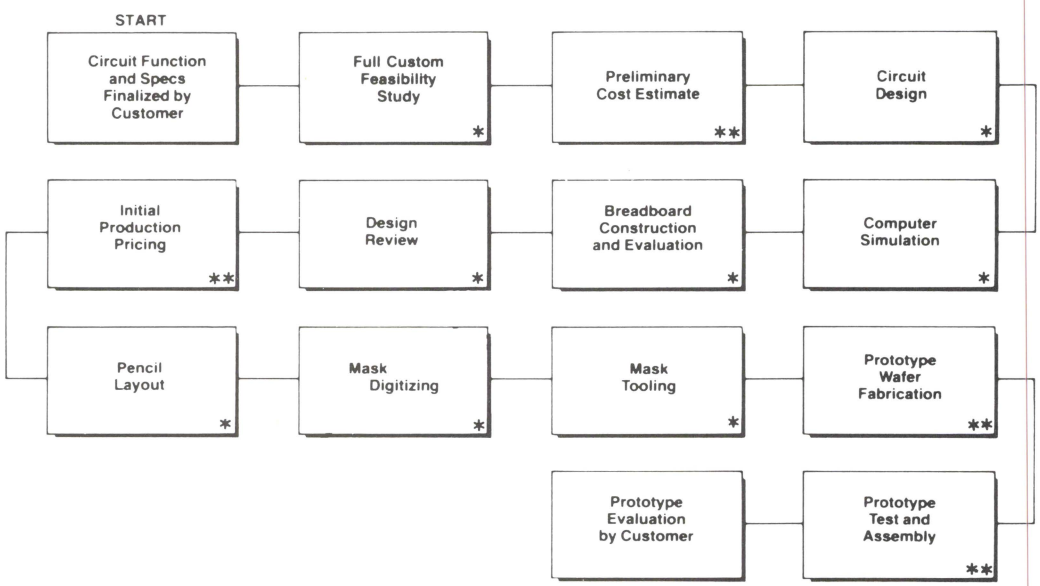
1. Circuit block diagram with subblocks.
2. Circuit schematic or logic diagram.
3. Description of circuit operation and pertinent application information.
4. Preliminary or objective device specification indicating min/max conditions and limits for the critical parameters; i.e., input/output voltage and current levels, operating frequency, timing diagrams, input/output impedances, power dissipation, etc.
5. Production requirements and the desired development timetable.
6. Packaging requirements.
7. Level of screening required.

IC FABRICATION FROM CUSTOMER'S TOOLING

Exar has a complete in-house silicon wafer fabrication and processing line at its main manufacturing plant in Sunnyvale, California. This facility currently runs 3-inch silicon wafers and will soon add 4-inch capability, and is also available for manufacturing custom IC's directly from a set of customer supplied IC tooling, in coordination with Exar's Mask Design department.

If you have a set of IC tooling (masks and composite overlays) or are contemplating having one designed for you, Exar's technical staff will be glad to review it for you to assure compatibility with Exar's technology and layout tolerances. Our wafer processing technology and capabilities are compatible with the industry standards, and with the technologies of other leading IC manufacturers.

For additional information on Exar's wafer fabrication services, contact Exar directly. We pride ourselves in our flexibility and quick response to your needs.



*If these steps are not done by Exar they should be done in consultation with Exar.

**These steps must be done by Exar.

FLOW CHART OF TYPICAL FULL CUSTOM DEVELOPMENT

TESTING OF SEMI-CUSTOM IC's

All production units of semi-custom IC's are 100% electrically tested and screened to test specifications which have been mutually agreed upon between Exar and the customer, using one of Exar's several computerized test systems. In addition, Exar's Quality Assurance department performs an independent set of electrical tests on randomly selected samples of production units, prior to shipment, to assure conformity with Exar's Acceptable Quality Level (AQL) standards.

EXAR's TEST CAPABILITIES

Exar can perform two basic types of tests for production IC's: (1) parametric testing which measures a specific parameter value (normally current or voltage) and compares it against pre-established limits; (2) functional testing which applies a series of operating conditions and compares the circuit under test with a known good device. These two types of tests can be performed both as steady state (dc) or dynamic (ac) measurements.

Exar provides 100% electrical testing of IC chips in wafer form, using automated wafer probe stations, and in packaged form, using automatic handlers. Exar's test facility currently has fifteen independent computer controlled test systems, with more being added as we grow. Exar's automated test system compliment is comprised of:

- Teradyne A311
- Teradyne A312
- Teradyne A360
- Teradyne J273
- Fairchild 5000C

Testing is one of the most critical steps in IC production. Therefore, to insure efficient and cost effective testing of production IC's, it is essential that a preliminary test plan be prepared jointly between the customer and Exar at an early stage of the custom development. This preliminary test plan will lead to the final detailed test specifications, once the development prototypes are fully evaluated and characterized and the circuit is ready to release to production.

TEST INTERFACE DEVELOPMENT

The performance and characterization data derived from careful prototype evaluation is the basis upon which test hardware and software is developed. Exar and the customer will jointly determine the performance expectations to be placed on this new IC, and once these specifications are agreed upon, Exar will proceed with test development.

Test development involves the design and construction of a test interface circuit, probe card and automatic handler hardware as well as writing the software which allows Exar's test system to perform the desired electrical tests. All these elements are then brought together under actual production conditions for evaluation and system debugging. This process can take from four to six weeks to complete, depending on the sophistication and complexity of the test plan under development. Test development begins concurrently with the start of production wafers (which require approximately 6 weeks to process).

SPECIFICATION AGREEMENT LETTER

With each new custom IC Exar issues a Specification Agreement Letter. This specification states precisely the test conditions, performance levels and environmental requirements which each production IC must meet before it can leave our factory, and is the document upon which acceptability of the IC is judged. It is issued in duplicate and signed by responsible representatives from both companies prior to beginning production. One copy is retained by the customer, the other is returned to Exar.

If, for some reason, changes in the IC's specification are required, a new Specification Agreement Letter will be issued by Exar reflecting these changes. No change, however, will be put into effect until both companies have signed the new agreement. This document will then supercede all prior agreements and remain in effect until both firms, again agree, a change is required.

LINEAR SEMI-CUSTOM DESIGN

COMPONENT UTILIZATION

The total number of components on the Exar Linear Master-Chips range from 110 on the XR-C100A to 882 on the XR-W100. However, the number of these components that are actually usable depends upon many considerations. The first thing that must be evaluated is the general requirements of the finished circuit. Factors such as the number of pins that are required, breakdown voltage as well as die size limitation imposed by packaging requirements, determine which of the Master-Chips are suitable. This can impose limitations on the number of available components.

Circuit characteristics also impose limitations upon the number of usable components. For example, a circuit whose package pin configuration can be chosen freely, that handles small signals, low supply voltages, is insensitive to dc offset voltages, and whose various circuit blocks follow one another with a minimum of interconnections between blocks, may be able to use over 90% of the components on the selected Master-Chip.

On the other hand, in more complex designs requiring special layout or design considerations, the component utilization may be as low as 50%. Examples of such cases are those where the package pin-outs are predetermined, or the choice of component locations on the die may be fixed due to thermal consideration, circuitry symmetry or offset requirements. In certain cases the series or parallel connection of several resistors to obtain a predetermined value, or paralleling several transistors to increase their current handling capability, may also limit the total component utilization.

Over 850 custom programs have been completed to date, using Exar's bipolar Master-chips. Thus, Exar's Engineering department has a great wealth of experience concerning the layout techniques utilizing the Master-Chips. In many cases, it is advantageous for the customer to call Exar for a free consultation regarding the choice of a particular Master-Chip which may be best suited for his application.

The bipolar Master-Chips are laid out to provide easy routing of metal interconnection paths. In addition, a multiplicity of low resistance crossunders are provided on the chip to simplify the interconnection layout.

LINEAR MASTER DESIGN KIT

A Linear Master Design KIT, containing a wealth of IC design and layout knowledge, is available from Exar for $59.00. This design KIT shows a step-by-step approach to convert your existing discrete linear circuits into a CUSTOM IC.

This design manual explains in detail the Bipolar Technologies employed. Component characteristics are clearly detailed to assist you during your paper design. In addition to circuit design and layout examples this KIT includes Testing, Quality Assurance and Packaging information.

Also included in the Master Design KIT are breadboarding components (KIT parts). These KIT parts come from the same Bipolar Process (20V, 36V, 75V) that will be used to integrate your circuit, thus minimizing any unforeseen processing risks.

The KIT parts included in the Master Design KIT are for your preliminary survey. After you have selected a particular Master-Chip for your design, then appropriate KIT parts will be mailed to you upon receipt of your order.

TECHNICAL ASSISTANCE

If any special or unusual circuit design or layout problems are encountered in the preparation of your semi-custom IC layout, Exar's technical staff will be glad to review your design problem and provide technical guidance. In many cases, it is beneficial to call Exar for a preliminary discussion of your custom IC needs even before you decide to buy a design kit.

BREADBOARDING

After a circuit has been designed and analyzed on paper, it is time to reduce the theoretical design to a functioning circuit that will duplicate, as closely as possible, the operation of the finished integrated circuit. This is the purpose of breadboarding. A great deal of care needs to be taken during this phase of IC development. Accurate breadboarding will not only allow you to gain an accurate assessment of the performance you can expect from the finished IC, but it will also allow you to discover circuit design flaws. A correctly connected, nonfunctional breadboard is a very vivid indication that something has been overlooked. Changes can be made

on a breadboard in a couple of minutes with a pair of pliers and a hot soldering iron. Changes on an IC are much more expensive and time consuming. The breadboard can be tested over temperature in a temperature chamber and circuit performance can be measured with worst case resistor values. Preliminary test specifications can also be readily developed from a properly functioning breadboard. Next to the initial paper design, breadboarding is the most important step in IC development.

KIT PARTS

Since the purpose of breadboarding is to build a circuit that will duplicate, as closely as possible, the performance of the finished IC, Exar has included with this design kit a generous supply of kit parts. These kit parts are the same integrated components that you will find on the finished IC. They are metalized and brought out individually so that you can use them to connect your circuit.

Generally speaking, the integrated resistor arrays need only be used in circuits where certain characteristics of these resistors, such as high frequency response or temperature coefficients, are critical to circuit performance. In most cases, standard off-the-shelf carbon film resistors are entirely adequate for breadboarding.

LINEAR SEMI-CUSTOM DESIGN CYCLE: SIX SIMPLE STEPS

The basic linear semi-custom design program involves only *6 single steps*, from the beginning of circuit design to the completion of monolithic prototypes. The first four of these steps can be done by either the customer in consultation with Exar or by Exar. The last two are performed by Exar.

	Step 1
Circuit design and breadboard using Linear Design Kit.	Customer purchases Exar's Linear IC Design Kit, made up of a comprehensive Design Manual and monolithic kit parts. The circuit is designed, breadboarded and its performance evaluated using these kit parts. The electrical characteristics of the kit parts Are virtually identical to the component which will be on the finished IC chip. Thus, this step provides a true simulation of the final IC performance.
	Step 2
Circuit layout is prepared	After the completion of breadboard evaluation, a layout of the circuit on the selected Master Chip by following the basic layout rules given in the Design Manual. The layout is done simply by interconnecting appropriate device terminals with pen or pencil lines on oversize drawings of the Master Chips supplied with the kit.
	Step 3
Layout review	Exar reviews the circuit layout and schematic to check the following: a) That basic circuit function is feasible b) No layout rules are violated c) Circuit layout accurately represents the circuit schematic. *NOTE: Exar offers consulting service and design advice during these first three steps.*
	Step 4
Exar generates custom interconnection pattern.	Using the completed Master-Chip layout sheet, Exar generates a custom interconnection pattern, or metal mask to be applied to pre-fabricated Master-Chip wafers.
	Step 5
Exar fabricates customized IC wafers.	Exar applies the custom interconnection patterns to pre-fabricated Master-Chip wafers. During this customization process, the hardware and software necessary to test the prototypes is made ready. After the wafers are customized, each die is tested by an automatic tester.
	Step 6
Exar assembles and delivers monolithic prototypes.	The customized IC wafers are scribed or cut into individual IC chips. After a visual inspection, several die that tested "good" are assembled in cerdip packages. These packaged devices are then tested again before shipment. Fifty assembled IC's, and test data for correlation purposes, are sent to the customer in a prototype package that includes a die photo, device schematic test details and a layout sheet.

▶ FULL CUSTOM DESIGNS

EXAR offers direct full custom designs to its customers. However, recognizing the risks, costs, and longer turnaround times involved in full custom development, EXAR also provides full custom conversions.

Full custom conversion is a two-step approach that provides the best of both worlds; quick turnaround time with minimum risk of semi-custom arrays, and the efficient use of silicon with full custom which invariably means reduced unit costs.

The first step is to implement customer's design on one of EXAR's **Master-Chips** to take advantage of the fast integration times as well as very easy, fast and low risk design iteration cycle in comparison to full custom. This enables customers to design and penetrate their product into the market in a short time frame and qualify the product for production rapidly. In addition, any application or production problems that may require design iterations can be implemented at a low cost and with a fast turn-around time. This way, all production oriented problems are fully debugged and the device is production proven in semi-custom form.

The second step, then, would consist of a straightforward full custom conversion to minimize the chip size and hence the unit cost when the device is in full production. This ensures a risk free and a very smooth transition to shipping cost effective, high volume products.

▶ STANDARD CELL LIBRARY

EXAR has developed an extensive library of fully characterized linear standard cells, and is in the process of expanding the library continuously. EXAR presently has over 100 different, fully characterized linear standard cells.

Linear standard cell technique allows customers to design an entire integrated circuit from base layer up, similar to a full custom development without suffering from some of its disadvantages. Please contact EXAR for further information on its Standard Cell Library.

Again, EXAR's state-of-the-art in-house wafer fabrication facility is a key factor in providing highly reliable full custom and standard cell products.

▶ DESIGN MANUALS AND KIT PARTS

A Linear Master-Chip Design Manual is available from EXAR for $59. This manual shows a step-by-step approach to the design and layout of circuits. It covers one of the most comprehensive and useful analog circuit design aids in the industry, including extensive device characterization, modelling, predesigned circuit examples and circuit building blocks as well as layout examples. Also contained in this manual are breadboard kit parts which will be used to prove the performance of your circuit. These kit parts come from the same bipolar process that will be used to integrate your circuit. Additional kit parts are available at $2.50 each.

▶ THREE STEPS TO SUCCESS

Get EXAR To Work For You

Step 1: Discuss Your Needs With EXAR

We are proud of our quick and flexible response to your needs. During the conception stage of your project, our highly talented Design Engineers can go through the technical options and variations available to you through EXAR. This is done at absolutely no cost to you.

Step 2: Get a Quotation From EXAR

To help us get an accurate and complete quotation to you faster, your request for quotation (RFQ) should contain:

- ☐ A block diagram of your application
- ☐ A schematic at discrete or transistor level
- ☐ The circuit specifications
- ☐ Your volume requirements

The more information you supply us, the sooner we can respond. EXAR can also assist you in compiling this information.

Step 3: Relax and Enjoy The Services Offered by EXAR

Depending on your requirements, a project may be started with EXAR at YOUR desired level of involvement. EXAR engineering having successfully completed over 1000 user specific projects (automotive, industrial control, telecom, modems, computer peripherals, medical and switch capacitor filter applications), has the necessary expertise to be involved in system design, IC design, layout or integration level. YOUR CHOICE. In either case, throughout the development process, a close contact is maintained between EXAR and your staff. NO SURPRISES.

In addition to our extensive engineering expertise in various user specific applications, as a standard IC manufacturer, EXAR brings years of accumulated engineering know-how and expertise in telecommunications, computer peripherals, data communications, including switch capacitor filters and modems, industrial control, and instrumentation to our customers. All this design expertise is available to you. Make use of our easily acessible wealth of valuable engineering resources now.

EXAR also offers a variety of DIGITAL GATE-arrays. These include state-of-the-art dual metal 3μ Si-GATE arrays for high speed applications and metal gate CMOS arrays for high voltage applications.

▶ SERVICES OFFERED

Depending on the annual volume requirements of the customer and the selectivity criteria, EXAR offers a wide variety of Engineering services. These services are briefly outlined below:

1. System Design: This type of design service evolves from the conceptual system description and specification. It requires EXAR to come up with the system design using a block diagram approach. It requires definition of the functional blocks and system implementation with discrete IC blocks to verify the performance, as per the objective specs. Discrete IC implementation of each functional block and determination of the product or circuit specifications required to meet the system performance concludes the System Design.

2. Circuit Design: In this type of service, the system is well-defined by the customer in block diagrams and at the discrete IC level. EXAR determines the partitioning of the system and the definition of the product and objective specs. Then the transistor level design of the circuit is implemented to meet the IC specs. For circuit simulation, EXAR's **Master-Chip** models with SPICE/ASPEC programs are also available.

The circuit is breadboarded using the kit parts of the appropriate **Master-Chip**. A fully evaluated and finalized breadboard is submitted to the customer together with the evaluation results and performance characteristics for approval.

3. Design Assistance: This service is intended as a joint effort between EXAR and the customer's engineering staff. EXAR's Engineering Staff will work very closely with the customer to define the system and the objective IC specs to achieve the desired performance. EXAR's Engineering Staff will then provide the customer with a conceptual transistor level paper design of the circuit. It will be the customer's responsibility to breadboard and troubleshoot the circuit. EXAR will provide "handholding" during this stage, and assist the customer in determining the test specs and layout of the circuit (optional).

4. Layout: After the transistor level circuit schematic of the breadboard is finalized, the 200X **Master-Chip** layout sheets or Electronic Layout Sheets are used to do the interconnect. Since the interconnections of the circuit on the Master-Chip is an integral part of the design and can have a significant effect on the performance of the circuit, all critical paths and matched circuit components must be identified and taken into consideration in achieving an optimum layout. This layout sheet along with the test specification of the circuit, provided by the customer, and the pin-out (bonding diagram) form the integration package.

5. Integration: This service involves generating silicon from the layout sheet. After the Integration Package is ready, EXAR will take the layout sheet and digitize it. At this stage, EXAR will check the digitized plots versus transistor level circuit schematic. After digitization, Design Rule Check (DRC) is performed to eliminate any violations. The final digitized plots are then used to generate masks (working plates) using automated techniques.

Finally, metallization and passivation (glass or nitride) masking steps are performed on EXAR's premises to finish fabrication of the **Master-Chip** wafers. After the wafer fabrication is completed, prototypes are built at EXAR's in-house Hi-Rel assembly facility.
The prototypes are then fully evaluated and sent to the customer along with a prototype binder which includes all pertinent information. These prototypes are for electrical evaluation purposes only.

6. Wafer Foundry: In addition to all the services mentioned above, EXAR offers wafer foundry services utilizing its in-house state-of-the-art wafer fabrication line which includes all diffusion processes, epi, ion implantation, and a wide variety of deposition processes. Technologies offered cover all bipolar processes, including I^2L and high voltage, as well as metal and silicon gate CMOS. Services are also available for partial or full processing of wafers using customer owned emulsion or chrome tooling.

▶ CAE/CAD CAPABILITIES

For years EXAR has been using CAE/CAD design tools extensively for digital gate arrays. Capitalizing on this expertise and implementing technical innovations, we are proud to be the first to introduce design automation utilizing CAE/CAD tools into the area of linear semi-custom arrays. The linear CAE workstation concept, by eliminating the handcrafted layout methods, takes the black magic out of linear semi-custom design. This new, fully-automated linear, semi-custom design methodology utilizes CAE/CAD Daisy "Gate Master" workstations and dual layer metal linear semi-custom arays.

Auto placement and auto routing workstations drastically reduce the layout and digitizing turnaround times with added reliability. This built-in "correct by construction concept" is attained through on-line layout versus schematic (LVS) check, design rule check (DRC), and electrical rule check (ERC) features included in the design automation software. An additional benefit of design automation is the achievement of higher packing density (higher percent utilization) which enables EXAR to use smaller **Master-Chips** and to pass the cost savings on to our customers.

▶ MODELS AVAILABLE

For running simulations, SPICE model parameters (AC/DC) are available on bipolar (20V. 36V and 75V) and Bi-FET (36V, ion implant) processes. Contact EXAR for further information.

EXAR LINEAR MASTER-CHIPS

The following section profiles the available Exar linear Master-Chips.

INDUSTRY STANDARD (20V) ARRAYS

	A-100	B-100	C-100A	D-100	E-100	F-100	G-100	H-100	J-100	L-100	M-100
Transistors											
NPN, small	58	69	23	50	48	93	58	73	36	76	137
NPN, 100mA								2	2	2	4
NPN, 200mA	2					4	2			2	4
NPN, low noise											4
PNP, single collector	18	12	8								
PNP, dual collector				16	15	36	18	22	12	22	44
PNP, quad collector										4	8
PNP, vertical											4
Schottky Diodes	15	16	6								
15 N + Resistors								4		8	15
Base Resistors											
200Ω	16	28	8	15	6	18	19	33	8	27	60
450Ω	43	44	18	30	41	88	68	87	34	106	188
900Ω	43	46	20	28	34	68	65	81	30	78	140
1.8KΩ	29	39	13	29	27	61	44	60	24	53	104
3.6KΩ	28	36	12	24	30	61	27	36	20	36	84
Total Base Resistance	214K	266K	94K	178K	206K	433K	266K	356K	159K	348K	712K
Pinch Resistors											
30KΩ	4	6	2		5	9					
100KΩ	4										
60KΩ				2			8	8	4	10	16
90KΩ		6									
Pads	16	16	14	16	18	24	18	18	18	24	28
Die Size (mils)	73x83	85x85	56x62	80x81	82x82	98x115	90x90	95x80	80x75	102x85	176x121

HIGH VOLTAGE (75V) ARRAY

	X-100
Transistors	
NPN, small	30
NPN, 100mA	
NPN, 200mA	4
PNP, dual collector	16
20Ω XU	1
Base Resistors	
500Ω	64
1KΩ	27
2KΩ	58
5KΩ	12
Total Base Resistance	234K
N+ Resistors	
2.5 Ω	14
5 Ω	7
12 Ω	7
Pinch Resistors	
100K Ω Pinched	3
30K Ω Pinched	3
Pads	18
Die Size (mils)	115x95

BI-FET (36V) ARRAYS

	U-100	V-100	W-100
Transistors			
NPN, small	94	140	192
Supermatched small NPN's			16
NPN, 100mA	2		
NPN, 200mA		4	4
J-FET (P-channel)	4	4	8
PNP, dual collector	40	56	60
PNP, (med. vertical)	2	4	4
PNP, vertical	8	4	10
Base Resistors			
200Ω	40		
280Ω		40	24
450Ω	158	112	100
900Ω	56	72	100
1.8KΩ	32	64	88
3.6KΩ	32	56	72
Total Base Resistance	305K	443K	559K
Implant Resistors			
1KΩ			32
5KΩ	16	32	32
10KΩ	16	32	32
20KΩ	16	32	32
50KΩ	16	32	28
Total Implant Resistance	1.36M	2.72M	2.55M
Cross Unders			
15Ω XU	9	4	
5Ω XU		8	
30Ω LVXU (5V max)		8	
15Ω LVXU	4	4	
Capacitors			
MOS capacitors (10pF max)	4	4	8
Pads	28	28	40
Die Size (mils)	110x110	146x113	163x133

NOTE: LV—low voltage (5V max. to substrate). XU—N + cross under

CELLULAR (20V) ARRAY

	CA-100
Transistors	
NPN, small	96
NPN, 100mA	
NPN, 200mA	2
NPN, low noise	4
PNP, large	2
PNP, dual collector	60
8Ω LV XU (5V Max) to substrate	16
28Ω N + Resistors	22
16Ω N + Resistors	18
20Ω N + Resistors	20
30Ω N + Resistors	4
Base Resistors	
400Ω	80
800Ω	42
2KΩ	42
2.4KΩ	32
Total Base Resistance	226K
Implant Resistors	
3KΩ	28
9KΩ	38
27KΩ	38
36KΩ	28
Total Implant Resistors	2.46M
Capacitors	
Junction Cap (5V diff max 25pf)	4
MOS Capacitor (Max 10pf)	2
Pads	28
Die Size (mils)	122x77

I^2L ARRAYS

Array-Name	Gate Count*	Schottky Bi-Polar I/O Interfaces	Bonding Pads	Operating Voltage	Max. Toggle Frequency	Internal Delay/Gate	Note Ij = Injector Current
XR-200	192	24	30	7V	60 KHz	0.6μs	@ Ij = 1μA
XR-300	288	28	34	7V	400 KHz	100ns	@ Ij = 10μ
XR-400**	256	18	40	7V			
XR-500	520	40	42	7V	2 MHz	50 ns	@ Ij = 100μA

*5 Output I^2L gates

**XR-400 also has PNP, NPN devices and diffused resistors to allow analog and digital functions on the same chip.

FLEXAR™

FLEXIBLE LINEAR ARRAY

OUR PNP IS AN NPN

Select an NPN or a PNP from a specific location by using only a single layer of metal without regard to the polarity of the transistor.

OUR BONDING PAD IS A TRANSISTOR

When not required as a bonding pad it may be programmed to function as a transistor capacitor, or a resistor.

SEMICUSTOM AT FULL CUSTOM PRICES

The total production cost is lower than full custom for quantities well above 100,000 units (including NRE) with much faster turnaround and less risk. Up to 100% utilization is possible with one metal layer only.

PROTOTYPES IN HALF THE TIME

FAST LAYOUT—Reduction in the layout phase due to the cellular, grid format and easy to route, multi-function components.

FAST DESIGN—Reduction in the design cycle with the availability of the SOFT-CELL Library. Simulate your design at system level and you're on your way to silicon.

SEMI CUSTOM FOR SYSTEM ENGINEERS

Now, for the first time, system engineers can design an IC by using the soft-cell library without getting into the transistor level schematic.

TRANSFERABLE BUILDING BLOCKS

Any block can be transferred to any location on the same chip or on other chips in the family keeping the same layout and unchanging characteristics.

HIGHER RELIABILITY

A new four layer passivation system, better layout techniques to improve step coverage, ESD protection, excellent low current performance of NPN/PNP's, and parasitic protection diodes available at each pad greatly increase the reliability.

ULTIMATE FLEXIBILITY

Designed to work with CAE/CAD tools, and on chip zener trimming, low voltage operation, suited for digital applications, symmetric architecture, improved repeatability, and the extensive usage of implant techniques in addition to its other features make FLEXAR™ the revolutionary array in linear semicustom.

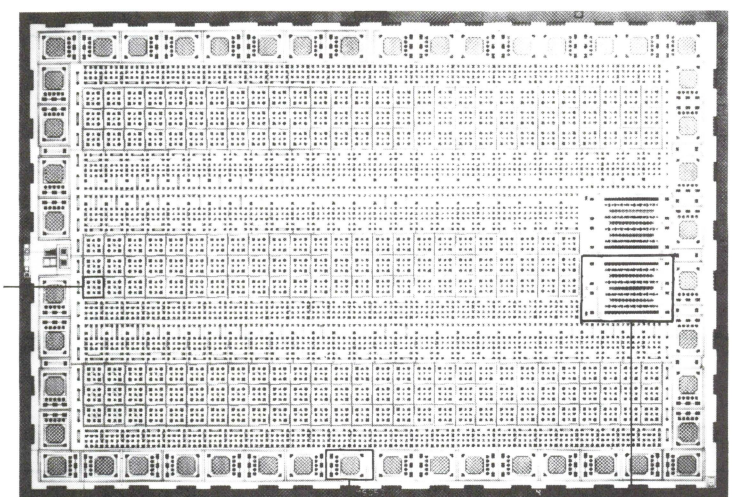


FIGURE 1

A. TWINSTOR
The work horse of FLEXAR.™ Use it as a NPN, PNP, SCR switch, or matched pair of resistors.

B. TWINBOOSTOR
A high power TWINSTOR. Drive a 500 mA load as a power NPN or a 50 mA as a PNP.

C. PADSTOR
A multipurpose bonding pad. Use it as a NPN or PNP transistor component when not needed as a bonding pad.

FLEXAR™ COMPONENTS

Three multifunction components (TWINSTOR, PADSTOR, and TWINBOOSTER) in FLEXAR™ family of linear/digital arrays and the continuity of the topology of the FLEXAR™ series are unique to the industry. For the first time each component can be programmed to serve as one of many active or passive functions. The designer defines the desired function by proper connections with the single metal layer.

FLEXAR™ CELL ARCHITECTURE

The architecture of the FLEXAR™ array is built around a flexible CELL which is repeated throughout the array and on the other arrays of the family. This enables a circuit to be duplicated anywhere within an array or transferred from one array to another with unchanged characteristics. The designer's task becomes greatly simplified for the same layout may be placed in any location and on any array in the family giving a major reduction in design cycle. This is far superior to the typical semicustom IC which does not have this cell structure. Before the introduction of FLEXAR™, a new layout would have been required if the same circuit was to be transferred from one array to another or even to a different location on the same array.

Each cell contains three TWINSTORS flanked by two resistor arrays as shown in figure 2. The resistor arrays are part of the four independent resistor islands (see figure 1). Array A, in figure 2 , contains 3K ohms base resistance, 10K ohms implant resistance, a 20 ohm P-type crossunder and a low current bias contact to V+ (the most positive supply). Array B, in figure 5 on the right, contains 5.5K ohms base resistance, 35K ohms implant resistance, two P-type crossunders (20 and 25 ohms), an independent bias contact, a low current substrate and a wide preassigned V+ track running perpendicular to the 1.5K ohm resistors. Interconnections between CELLS become simple and make the layout compact and efficient.

When the TWINSTORS are not used as active elements, each TWINSTOR may be used either as a 20 ohm crossunder or as a 480 ohm matched resistance pair conveniently close to the active elements.

FLEXAR™ ARRAY

COMPONENT COUNT

	BETA 240	BETA 180	BETA 100
CELLS	80	60	33
TWINSTOR NPN OR PNP	240	180	99
PADSTOR OR PADSTOR AS			
NPN	48	40	30
PNP	48	40	30
Resistor	48	40	30
Capacitor	48	40	30
Bonding Pad	48	40	30
TWINBOOSTOR NPN OR PNP	2		
Base Resistors			
500 ohm	880	660	363
1.5K ohm	160	120	66
Total Base Resistance	680KΩ	510KΩ	280KΩ
Ion Implant Resistors			
5K ohm	320	240	132
25K ohm	80	60	33
Total Implant Resistance	3.6MΩ	2.7MΩ	1.5MΩ
P+ Crossunder Resistors			
(XU4) 25 ohm	80	60	33
(XU3) 20 ohm	160	120	66
(XU5) 20 ohm (PADSTOR)	48	40	30
N+ Crossunder Resistors			
(XU2) 15 ohm (PADSTOR)	96	80	60
(XU6) 15 ohm	25	10	10
DIE DIMENSION	110x160mils	110x122mils	110x79mils

DESIGNING WITH SOFT CELLS

A Soft Cell is a predesigned, fully characterized, circuit that is ready to be implemented on any of the FLEXAR™ family of arrays. The soft cell approach makes the design of an IC simple. An engineer not familiar with IC design can, for the first time, reduce a working circuit to an IC just be following these simple steps:

1. Draw a block diagram of your system.
2. From the vast library of soft cells provided by EXAR choose the appropriate soft cell for each block.
3. Connect the soft cells to form your circuit.
4. Simulate your circuit on your own computer or use EXAR's.
5. Layout your circuit or let EXAR do it for you using our Auto-Place and Route technique.
6. EXAR is always ready to support you by picking up the project from your building block concept, or at any other stage.
7. EXAR will provide functionally tested prototypes → ***FAST!***

COMPACT MACRO-CELL

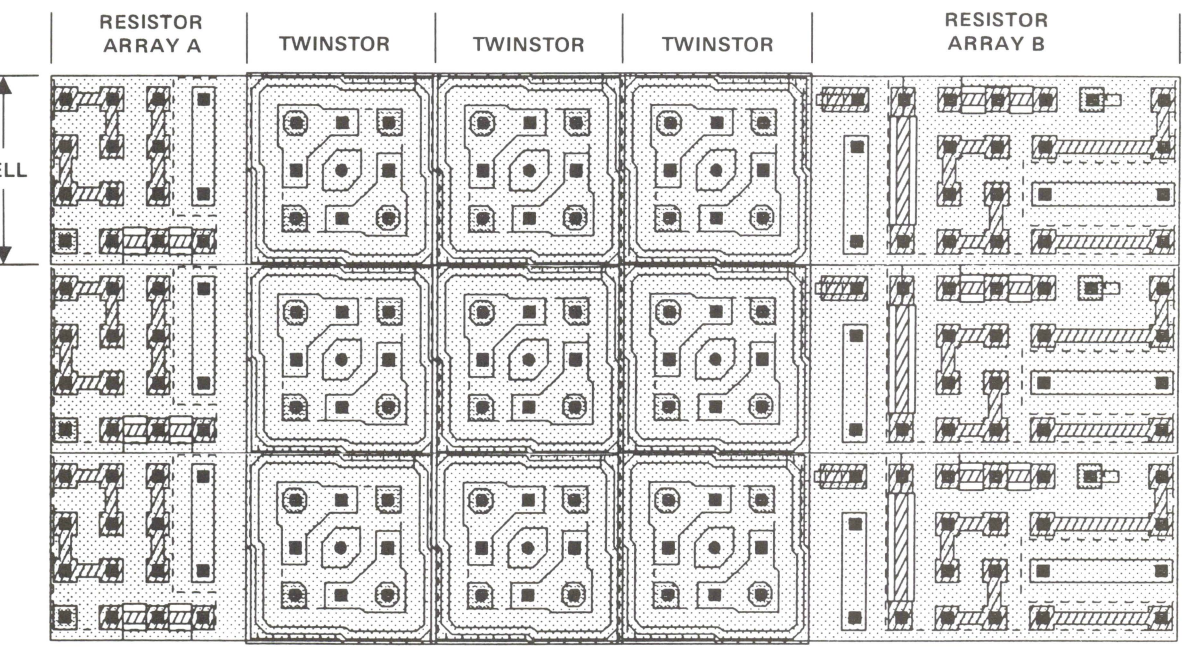
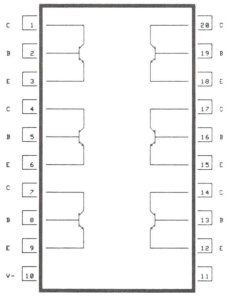


FIGURE 2

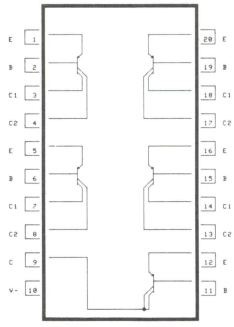
FLEXAR™ KIT PARTS

The simplicity and ease of designing with the FLEXAR™ array is demonstrated by the fact that ONLY FOUR different types of KIT PARTS are required to breadboard and check your design.

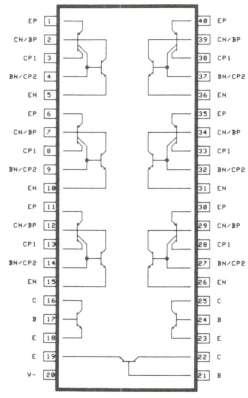
The simplicity and ease of designing with the FLEXAR™ array is demonstrated by the fact that ONLY FOUR different types of KIT PARTS are required to breadboard and check your design.



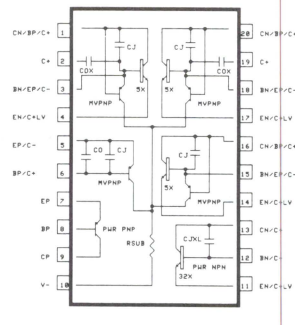
FLA-101
(TWINSTOR Programmed as NPN)



FLA-102
(TWINSTOR Programmed as PNP)



FLA-103
6 TWINSTOR—Programmable
3 TWINSTOR—Programmed as NPN



FLA-104
3 PADSTORS—Programmable
1 TWINBOOSTOR—Programmed as Power PNP
1 TWINBOOSTOR—Programmed as Power NPN

EXAR

Section 10—User Specific Digital ICs—Semi-Custom/Full Custom

STANDARD CELLS

Standard cells offer the ultimate in design flexibility and cost reductions. This approach allows single-chip integrations of diverse function types that cannot be realized using any other approach. In addition, the die-size and hence the unit-cost for the final product is considerably lower than a gate array design. However, since the development cost and lead times are longer, this approach is better suited for large production quantities or designs that cannot be realized using gate arrays.

A typical standard cell development flow is shown in Figure 1. Listed below are the steps to be performed at each stage. It should be noted that in standard cell devices, working plates (masks) must be generated for all layers, unlike gate arrays, where only the interconnect layers need to be generated.

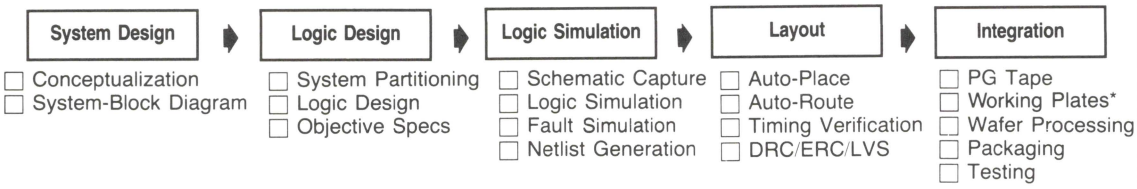


Figure 1. Standard Cell Development Flow

ADVANTAGES OF STANDARD CELLS:
(Standard Cell Approach)

Flexibility in Design: Layout customized from bottom layer up.

Improved Turnaround: Predefined cells and auto placement/routing.

Higher Success Rate: Sophisticated CAD software eliminates missing or incorrect connection. Guaranteed functionality of the predefined cells.

Lower Product Cost: For higher production quantities the product cost in even lower than the gate arrays, this in spite of the higher NRE charges.

Macro Cells: The ultimate in the flexibility and integration is the ability to incorporate proven macro functions in the standard cells.

XR-P3000 STANDARD CELL LIBRARY

EXAR has developed an extensive library of fully characterized Standard Cells. XR-P3000 Standard Cells use a production-proven 3 micron, dual-layer metal, P-well CMOS technology. Dual-layer metal routing results in a much smaller die-size than comparable offerings in single-layer metal. Dual-layer metal interconnection also permits low resistance connections between critical nodes, thereby enhancing the performance of the devices.

XR-P3000 consists of approximately 50 characterized Standard Cells. A list of these cells is shown. These functions are designed with fixed height, variable width cells that make placement and routing very efficient.

XR-P3000 is fully supported on EXAR's integrated CAD/CAE system. The design schematic can be captured and simulated on this system, providing very clean documentation and preventing translation errors between design and simulation files. Placement and routing are done on this same system.

The XR-P3000 library undergoes continual expansion and upgrade. Enhancements currently underway include both digital and analog functions. Customers' requests for special cells are welcomed.

The XR-P3000 library of Standard Cells is accessible by the Futurenet and CDC schematic capture systems. Using these design capture systems and a simple modem-link, customers can complete their designs at their own sites. The modem-link provides access to the powerful CAD/CAE system in-house at EXAR. Customers can use this link for detailed and sopohisticated simulations. Electronic transfer of the final design to EXAR can be accomplished efficiently and without error.

EXAR has designed numerous special analog cells in recognition of customer requirements. Many designs with mixed analog and digital functions are already in production. These cells are available in the library.

The first-pass success rate using XR-P3000 Standard Cells is very high. This means cost-effective and time-efficient solutions for the user. When your product upgrade requires a more sophisticated library and/or technology, XR-N2000 offers the ideal choice.

STANDARD CELL LIBRARY

ABSOLUTE MAXIMUM RATINGS = T_A = 25°C

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	−0.3 – 6.5	V
Input Voltage	V_{in}	−0.3 – V_{DD} + 0.3	V
Output Voltage	V_{out}	−0.3 – V_{DD} + 0.3	V
Operating Temperature	T_{opr}	−20 – 75	°C
Storage Temperature	T_{stg}	−55 – 150	°C

OPERATING RANGE

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	5 ± 0.25	V
Input Voltage	V_{in}	0 – V_{DD}	V
Output Voltage	V_{out}	0 – V_{DD}	V
Operating Temperature	T_{opr}	0 – 75	°C

I/O CHARACTERISTICS: V_{DD} = 5V; T_A = 25°C

ITEM	SYMBOL	MIN	RATING TYP	MAX	UNIT	CONDITION
Input Voltage	V_{IL}			0.8	V	
	VIH	2.0			V	
Output Voltage	V_{OL}			0.8	V	I_{OL} = 2 mA
	V_{OH}	2.4			V	I_{OH} = 0.4 mA*

P3000 STANDARD CELL LIST

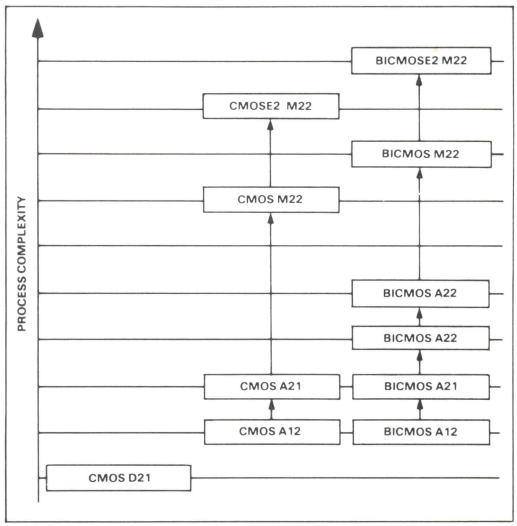
1. 2 Input AND – 2 Input OR – Invert
2. 2 Input AND
3. 3 Input AND
4. 4 Input AND
5. 5 Input AND
6. Bidirectional Buffer with Pad
7. Buffered Enable Transmission Gate
8. Schmitt-Trigger Buffer
9. Tri-State Buffer
10. Tri-State Buffer with Inverted Enable
11. Clock Buffer
12. Clock with Reset Flip-Flop
13. D Flip-Flop with Reset
14. D Flip-Flop with Reset and Set
15. D Flip-Flop with Set
16. D Flip-Flop
17. 2 Input Exclusive OR
18. 2 Input Exclusive NOR
19. Input Buffer, Input Normally Low
20. Schmitt-Trigger Input Buffer
21. Input Buffer with Pad
22. Tri-State Inverter
23. Tri-State Inverter with Inverted Enable
24. Inverter
25. Inverting Clock Buffer
26. Inverted Enable Transmission Gate
27. Latch
28. Latch with Reset
29. Latch with Reset and Set
30. Left End Cell
31. 2 Input MUX
32. 2 Input NAND, One Input Inverted
33. NAND Set-Reset Latch
34. 2 Input NAND
35. 3 Input NAND
36. 4 Input NAND
37. 5 Input NAND
38. 2 Input NOR, One Input Inverted
39. NOR Set-Reset Latch
40. 2 Input NOR
41. 3 Input NOR
42. 4 Input NOR
43. Output Buffer with Pad
44. Output Buffer with Test Pad
45. Output Buffer with Test Pad
46. 2 Input AND – 2 Input OR – Invert
47. 2 Input OR
48. 3 Input OR
49. 4 Input OR
50. Right End Cell
51. T Flip-Flop with Reset
52. Vertical Route Through
53. V_{DD} Pad
54. V_{SS} Pad
55. Op Amp

NOTE: This library is undergoing continual expansion and upgrade. Contact Exar to find out about additional digital and analog cells which are available.

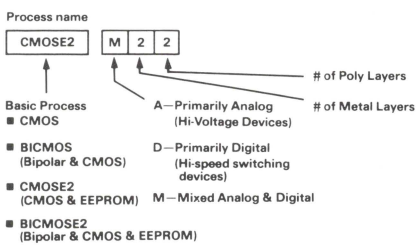
PRODUCT DESCRIPTION

The N2000 series of standard cells from EXAR Corporation is manufactured using an advanced 2 micron, double poly, double metal, CMOS process. This process is unmatched in its versatility and performance, providing the user with fast digital switching, precise analog functions, and dense memory, including EEPROM. This access to highly integrated, digital and analog solutions assures the associated system advantages that VLSI provides. The N2000 standard cell library offers high noise immunity and very low power consumption typical of CMOS technology. All inputs and outputs may be selected to be compatible with either TTL or CMOS logic levels or any analog signal from 0 to 15 Volts. The small geometries allow over 150 I/O signals and integration complexities up to 20,000 equivalent gates.

The N2000 library currently includes 125 digital cells, 25 analog cells and 20 memory macros of EEPROM, RAM and software configurable ROM. In addition to the current cells, EXAR will custom design new cells to meet specific customer requirements. The use of industry standard software and hardware allows the user a high level of involvement during the initial phases of integration. This user visibility insures the quick and accurate integration of the design.



EXAMPLE:



CMOSE2 M22—is a CMOS process with EEPROM and is suitable for mixed analog/digital type circuits with 2 layers of metal and 2 layers of poly.

PRODUCT FEATURES

- Two micron CMOS
- 3 to 15 Volt supply voltages
- Over 150 input/output pads
- Fast generation of user specific cells
  - —Digital silicon compilation
  - —Analog custom product experience
  - —Memory standard products up to 256K
- Extensive 125 cell digital library
  - —Toggle frequencies to 75 MHz
  - —Clock frequencies to 50 MHz
  - —1.0 nS typical 2 input NAND delay
  - —Output drivers to 48 mA
  - —Up to 20,000 equivalent gates
- Comprehensive 25 cell analog library
  - —Op amps, comparators, oscillators
  - —A/D, D/A, switched capacitor filters, phase lock loops
- Reconfigurable memory macros
  - —RAM, ROM, EEPROM
- Full MIL-STD 883 screening available
- Wide selection of packages available
- Dynamic digital and analog simulation environment
  - —−55 to +125°C
  - —Voltages from 3 to 15 Volts
  - —Best to worst case
- Complete design support from schematic capture to pattern generation.

MAXIMUM RATINGS

Storage Temperature	−65 to +150°C
Operating Temperature	−55 to +125°C
Supply Voltage, VDD	+3.0V to +15.0V
Voltage on any pin	VSS − .3V to VDD + .3V
ESD	3000V at 100pF thru 1.5k Ohms

10

DC OPERATING CHARACTERISTICS

VDD = 5.0V ±10%; Temperature = −55 to +125°C

PARAMETER	CONDITION	LIMIT	VALUE	UNIT
IOH, Output High Current	VOH = 2.4V	MIN	4.0	mA
IOL, Output Low Current	VOL = 0.40	MIN	4.0	mA
VIH, Input High Voltage	TTL Input	MIN	2.0	V
	CMOS Input	MIN	3.5	V
VIL, Input Low Voltage	TTL Input	MAX	0.8	V
	CMOS Input	MAX	1.5	V
IIN, Input Current	Digital	MAX	±5	uA
IDD, Supply Current	Active/Cell/MHz	TYP	1.5	uA
	Quiescent/Chip	TYP	0.10	uA
Capacitance				
Chip input	DIP Package	TYP	4.0	pF
Chip output	DIP Package	TYP	6.0	pF
Cell input		TYP	0.1	pF

AC OPERATING CHARACTERISTICS DIGITAL CELLS

VDD = 5.0V, Temperature = 25°C

PARAMETER	CONDITION	LIMIT	VALUE	UNIT
Propagation Time				
Inverter	0.5 pF Load	MAX	0.8	nS
2-input NAND	0.5 pF Load	MAX	1.0	nS
2-input NOR	0.5 pF Load	MAX	1.3	nS
Output Buffer	15 pF Load	MAX	3.7	nS
Frequency				
Flip Flop Toggle		MIN	100	MHz
Oscillator		MIN	100	MHz

AC OPERATING CHARACTERISTICS MEMORY CELLS

VDD = 5.0V, Temperature = 25°C

PARAMETER	CONDITION	LIMIT	VALUE	UNIT
Access Time				
256 x 8 EEPROM		MAX	100	nS
256 x 8 RAM		MAX	80	nS
256 x 8 ROM		MAX	60	nS

AC OPERATING CHARACTERISTICS ANALOG CELLS

VDD = 10.0V, Temperature = 25°C

PARAMETER	CONDITION	LIMIT	VALUE	UNIT
Opamp				
Gain Bandwidth		MIN	3.5	MHz
PSRR	1 KHz	MIN	90	dB
A/D Converter	8 Bits			
Resolution		MAX	½	LSB
Conversion Time		MAX	100	µS
D/A Converter	8 Bits			
Resolution		MAX	½	LSB
Settling Time		MAX	10	µS

GATE ARRAYS

Designing USICs using gate arrays is a well-known way to achieving cost-effective product with a quick turn-around. A CMOS gate array solution for USICs can be approached in two ways.

In one case, a customer may already have a working system on which it is necessary, for example, to reduce the manufacturing costs by incorporating a CMOS gate-array to simplify a complex printed circuit board. The task in this case is to determine what portion, if not all, of this PC board can be incorporated into an array. EXAR offers a very wide range of arrays to accomplish this.

The partitioning of the system and the choice of which array to use must be carefully considered with cost, packaging, versatility and testability in mind. EXAR's custom-engineering department will be happy to assist a customer in his selection, or perform a design review of the system at no cost and suggest array and partitioning alternatives. This design review will include a quotation for the development charges and production pricing of the array, as well as an approximation of the development time that will be required to build the prototypes.

In the second case, a design engineer may be in the process of designing a completely new system. In this case, the system can be designed in such a way that it can be easily partitioned into one or more arrays.

Once again, EXAR's custom-engineering department will be happy to provide assistance in selecting the appropriate array along with price and delivery information. EXAR plans to offer its soft macro library in both a PC-based environment and on popular workstations so that the schematic-capture can be performed electronically, thereby eliminating chances of an error and expediting the development cycle. Dial-up services will be available to help perform logic and circuit analysis using our powerful CAD/CAE tools in-house.

Also, if a customer so desires, the breadboards can be built using SSI and MSI packages from one of the popular logic families such as 74LXX, 74CXX or 4XXX. These logic families are recommmended for breadboarding due to their standard nature as well as their universal availability. EXAR custom-engineering will, once again, be happy to assist in translating these into EXAR's soft-macro library.

A typical semi-custom development flow is shown in the figure 1. Listed below are the steps to be performed at each stage.

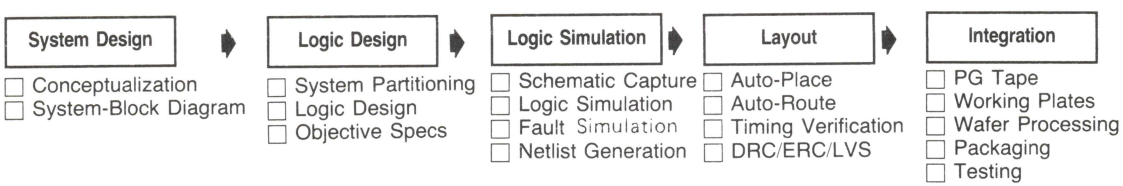


Figure 1. Gate Array Development Flow

10

ADVANTAGES OF GATE ARRAYS:

Lower Product Cost: With greater design integration, product costs are reduced.

Reduced Chip Count: Standard SSI and MSI parts are incorporated into a single chip, significantly reducing the chip count.

Improved Reliability: Fewer pins and solder joints improve the reliability.

Improved Speed: Reduced junction and node capacitances allows circuits to run at higher clock speeds.

Reduced Power Consumption: Reduced capacitive loads and CMOS technology also means the power consumption is significantly lower.

Smaller Products: Reduced chip count also means less parts and less board space. The result is a physically smaller product which offers the same solution.

Design Integrity: A User Specific IC provides protection against improper and unauthorized copying of the final product.

XR-30000 SERIES

The XR-30000 series of silicon-gate CMOS gate-arrays has been developed for high speed digital applications, with clock speeds as high as 25 MHz.

The series is composed of six different arrays ranging in gate-count from 156 to 3025 gates. The number of I/O pins on these arrays range from 22 to 98 and these are all tri-statable.

The 30000 series are implemented using a state-of-the-art 3 micron Si-gate CMOS, p-well processing technology. Special features like dual metal layers allow improved routability and impressive performance gains in both functionality and percentage utilization of the array.

The arrays use a set of common base layers, so the customization begins with the first contact and metal mask layers. This allows stocking of the wafers, finished until just before the first contact mask. Implementation is geared to provide a short turn-around time.

XR-30000 SERIES

ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	−0.3 – 6.5	V
Input Voltage	V_{in}	−0.3 – V_{DD} + 0.3	V
Output Voltage	V_{out}	−0.3 – V_{DD} + 0.3	V
Storage Temperature	T_{stg}	−55 – 150	°C

OPERATING RANGE

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	5 ± 0.25	V
Input Voltage	V_{in}	0 – V_{DD}	V
Output Voltage	V_{out}	0 – V_{DD}	V
Operating Temperature	T_{opr}	0 – 70	°C

I/O CHARACTERISTICS: V_{DD} = 5V; T_A = 25°C

ITEM	SYMBOL	MIN	RATING TYP	MAX	UNIT	CONDITION
Input Voltage	V_{IL}			0.8	V	
	VIH	2.0			V	
Output Voltage	V_{OL}			0.8	V	I_{OL} = 2 mA
	V_{OH}	2.4			V	I_{OH} = 0.4 mA*

AC CHARACTERISTICS: (T_A = 25°C)

ITEM	SYMBOL		RATING TYP		UNIT	CONDITION
Average Propagation Delay	t_{pd}		3.0		ns	Inverter with fanout = 2; V_{DD} + 5V
Toggle Frequency	f_t		25		MHz	V_{DD} = 5V

Si-GATE CMOS ARRAYS (DUAL METAL)

ARRAY NAME	GATE COUNT*	TOTAL I/O	TRISTABLE	BONDING	MAX OPERATING	TOGGLE	INTERNAL
30015	156	22	22	24			
30030	288	30	30	32			
30045	460	38	38	40	5V	35 MHz	<3 nS
30080	793	50	50	52			
30155	1548	70	70	72			
30300	3025	98	98	100			

* 2 input NAND equivalent

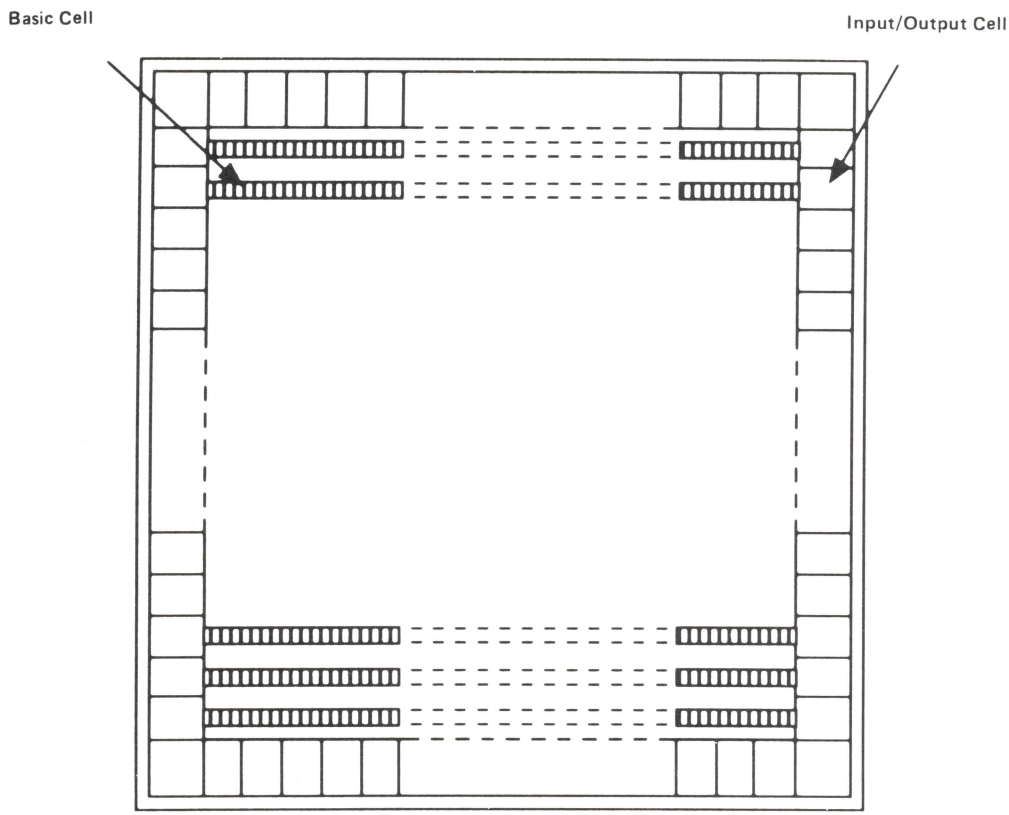


Figure 2. Chip Layout

XR-30000 SOFT-MACROS LIST

FUNCTION

1. Single Inverter
2. Double Inverter
3. Single Buffer
4. Double Buffer
5. AND Buffer
6. OR Buffer

7. 2 Input NOR Gate
8. 3 Input NOR Gate
9. 4 Input NOR Gate
10. 6 Input NOR Gate
11. 8 Input NOR Gate
12. 9 Input NOR Gate
13. 12 Input NOR Gate
14. 16 Input NOR Gate

15. 2 Input NAND Gate
16. 3 Input NAND Gate
17. 4 Input NAND Gate
18. 6 Input NAND Gate
19. 8 Input NAND Gate
20. 9 Input NAND Gate
21. 12 Input NAND Gate
22. 16 Input NAND Gate

23. 2-AND-NOR
24. 2-OR-NAND
25. 2-2-AND-NOR
26. 2-2-OR-NAND

27. Exclusive OR Gate
28. Exclusive OR Buffer
29. Exclusive NOR Gate
30. Exclusive NOR Buffer

31. RS Latch (NAND)
32. RS Latch (NOR)
33. R1R2S1S2 Latch (NAND)
34. R1R2S1S2 Latch (NOR)

35. D Latch
36. D Latch with Reset
37. D Latch with Set and Reset
38. D Flip-Flop
39. D Flip-Flop with Reset
40. D Flip-Flop with Set and Reset

41. Non-Inverting Input Buffer
42. Inverting TTL Compatible Input Buffer
43. Input Protection
44. Inverting Input Buffer
45. Schmitt-Trigger Non-Inverting Input Buffer
46. Schmitt-Trigger Non-Inverting Input Buffer
47. With Pull-Up Resistance

48. Inverting Output Buffer
49. Non-Inverting Output Buffer
50. Tri-State Output Buffer
51. Inverting Open Drain Output Buffer
52. NAND Output Buffer

53. Bidirectional Tri-State I/O Buffer
54. Unused I/O Cell
55. Inverting Bidirectional Buffer
56. Bidirectional Buffer with Tri-State Output

57. Schmitt-Trigger
58. 2 to 1 Multiplexer
59. Open Drain N Channel Transistor
60. Open Drain P Channel Transistor

CM SERIES

EXAR's CM series of digital gate-arrays is composed of four members: CMA, CMB, CMC and CMD – these range in size from 140 to 460 gates.

Each of the CM series array is completely prefabricated just like the 30,000 series, except for the final fabrication step of device interconnection.

The CM series is implemented using an 8 micron metal-gate CMOS, p-well processing technology. Implementation is geared to provide a short turn-around time.

As compared to 30,000 series, CM series can operate over a much wide supply range, V_{DD} = 3-15V. The clock speeds though, because of the larger geometries, are slower than the XR-30,000 series.

XR-CM SERIES

ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	−0.3 to +15.0	V
Input Voltage	V_{in}	−0.3 to V_{DD} + 0.5 V_{dc}	V
Output Voltage	V_{out}	−0.3 to V_{DD} + 0.5 V_{dc}	V
Storage Temperature	T_{stg}	−55 – 150	°C

OPERATING RANGE

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	3–15	V
Input Voltage	V_{in}	0–V_{DD}	V
Output Voltage	V_{out}	0–V_{DD}	V
Operating Temperature	T_{opr}	0 – 75	°C

I/O CHARACTERISTICS: V_{DD} = 5V; T_A = 25°C

ITEM	SYMBOL	MIN	RATING TYP	MAX	UNIT	CONDITION
Output Voltage (Low Level)	V_{OL}		0	0.1	V	V_{DD} = 5.0V
			0	0.1	V	V_{DD} = 10.0V
			0	0.1	V	V_{DD} = 15.0V
Output Voltage (High Level)	V_{OH}	4.95	5.0		V	V_{DD} = 5.0V
		9.95	10.0		V	V_{DD} = 10.0V
		14.95	15.0		V	V_{DD} = 15.0V

AC CHARACTERISTICS: (T_A = 25°C)

ITEM	SYMBOL		RATING TYP		UNIT	CONDITION
Average Propagation Delay (Inverter with fanout = 2)	t_{pd}		21		ns	V_{DD} = 5.0
			11		ns	V_{DD} = 10.0
			8		ns	V_{DD} = 15.0
Toggle Frequency	f_t		2.5		MHz	V_{DD} = 5.0
			5.0		Mhz	V_{DD} = 10.0
			8.0		MHz	V_{DD} = 15.0

ARRAY NAME	GATE COUNT*	TOTAL I/O	TRISTABLE I/O	BONDING PADS
CMA	140	29	15	32
CMB	202	34	16	38
CMC	270	40	22	44
CMD	416	46	30	50

* 2 input NAND equivalent

COMPUTER AIDED DESIGN AND ENGINEERING (CAD/CAE)

Key to EXAR's leading role in the USIC market are the CAD/CAE tools we offer to our customers. Our CAD/CAE system is fully integrated, meaning design capture, simulation, verification, layout placement and routing are all performed on one system.

Libraries, device models and process design-rules form the knowledge base of this integrated system. By taking care of mundane details, these CAD/CAE tools allow the designer to focus on the essence of the problem. The result is a dramatic reduction in the time it takes to realize working silicon.

Both the XR-30000 series Gate Arrays and the XR-P3000 Standard Cell library are fully supported on EXAR's CAD/CAE system. The library is also supported on the Futurenet and CDC design capture systems. A Tymnet link with EXAR's in-house VAX 8600 system allows customers direct access to these powerful tools.

The new XR-20000 series Gate Array family and the XR-N2000 Standard Cell library will also be fully supported on the system, and provide Futurenet and CDC design capture. In addition, the XR-20000 series designs will offer direct migration to the XR-N2000 series without need to recapture the design.

SOFTWARE TOOLS SUPPORTED

DESIGN PHASE	SOFTWARE PACKAGE	HARDWARE ENVIRONMENT
Schematic Capture	SDS Futurenet CDC	VAX 8600 PC PC
Logic Simulation	HILO3	VAX 8600
Pre-Layout Timing Analysis	HILO3 SIMON	VAX 8600
Mixed-Mode Simulation	SIMON HSPICE	VAX 8600
Test-Vector Generation	HILO3	VAX 8600
Fault-Grading	HILO3	VAX 8600
DRC/ERC/LVS	DRACULA	VAX 8600
Place and Route	CALMP	VAX 8600

In addition, other software packages and hardware environments will be supported as customer requirements dictate.

EXAR

Section 11—Application Notes

List of Application Notes

AN-01 Stable FSK Modem Featuring the XR-2207, XR-2206 and XR-2211
AN-02 XR-C240 Monolithic PCM Repeater
AN-03 Active Filter Design with IC Op Amps
AN-04 XR-C277 Low Voltage PCM Repeater IC
AN-05 Three Stage FSK Modem Design using XR-2207 and XR-2211
AN-06 Precision PLL System using the XR-2207 and XR-2208
AN-07 Single Chip Frequency Synthesizer Employing the XR-2240
AN-08 Dual Tone Decoding with XR-567 and XR-2567
AN-09 Sinusoidal Output from XR-215 Monolithic PLL Circuit
AN-10 XR-C262 High Performance PCM Repeater IC
AN-11 A Universal Sine Wave Converter using the XR-2208 and XR-2111
AN-12 Designing High Frequency Phase-Locked Loop Carrier Detector Circuits
AN-12 Frequency Selective AM Detection using Monolithic Phase-Locked Loops
AN-14 High Quality Function Generator System with the XR-2206
AN-15 An Electric Music Synthesizer using the XR-2207 and XR-2240
AN-16 Semi-Custom LSI Design with I2L Gate Arrays
AN-17 XR-C409 Monolithic I2L Test Circuit
AN-18 Designing Wide-Tracking Phase-Locked Loop Systems
AN-19 Clock Recovery System
AN-20 Building a Complete FSK Modem using XR-2211 and XR-2206
AN-21 Precision Narrow-Band Tone Decoder
AN-22 XR-210, XR-215, XR-S200 Phase-Locked Loops
AN-23 High Performance Frequency-to-Voltage Converter using the XR-2211
AN-24 Digitally Programmable Phase-Locked Loop
AN-25 Full Duplex 1200 BPS/300 BPS Modem System
AN-26 High Speed FSK Modem Design
AN-27 High Frequency TTL Compatible Output from the XR-215 Monolithic PLL Circuit
AN-28 XR-212AS Modem System
AN-29 XR-212ACS Performance Testing
AN-30 Speakerphone Design using XR-T6420-1 and XR-T6421
AN-31 PCM Line Interface using XR-T5680
AN-32 PCM Short Haul Line Interface using XR-T5681
Implement Bell T1C PCM Repeater using Just Two ICs by M. Kursat Kimyacioglu, EXAR Corp., article reprint

Applications Guide

Exar's line of monolithic IC products cover a wide range of applications. This *Applications Guide* is intended as a brief selection guide for the IC user, to assist him in finding the Exar product most suited to his application.

The application categories, or classes, are listed in alphabetical order, dictionary style, to allow the user to locate the product he needs at a glance. In certain applications, *two* of Exar's products used in combination may be necessary to perform the complete function. In such a case, these products are grouped together as a pair. For example, to make a complete FSK modem may require the XR-2206 Modulator and the XR-2211 Decoder. Thus, in the Applications Guide shown below, both of these products will be grouped under the Modem category as XR-2206/XR-2211.

In many of the applications, more than one product type is recommended. In such cases, the user can choose the device best suited to his specific application by either consulting with Exar's Applications department, or by reviewing the electrical specifications of the individual devices involved.

***ADVANCED INFORMATION**

A

Active Filters (Continuous Time)	XR-084, XR-094, XR-096, XR-346, XR-3403, XR-4202
Sampled Data	XR-1010, XR-1015, XR-1016
Acoustical Couplers (See Modems)	XR-2206, XR-2207, XR-2211
A/D Conversion (Pulse Counting Type)	XR-2240
Amplitude Detection	
Phased-Locked AM Detection	XR-215/XR-2228, XR-2212/XR-2228
Synchronous AM Detection	XR-S200, XR-2208, XR-2228
Amplitude Modulated Oscillator	XR-205, XR-2206
Crystal Controlled AM Oscillator	XR-S200, XR-205
Amplitude Modulation	XR-2206, XR-2208, XR-2228, XR-13600
Analog Computation	
Analog Multiplication/Division	XR-2208, XR-2228
Analog Square/Square-Root Operation	XR-2208, XR-2228
Analog-To-Frequency Conversion	XR-2209, XR-4151, XR-2917
Analog Sample-Hold	XR-13600/XR-082
Analog Semi-Custom Design (Master Chips)	XR-A100, XR-B100, XR-C100, XR-D100, XR-F100, XR-G100, XR-X100
Appliance Timing	XR-555, XR-556, XR-558, XR-559, XR-2240, XR-2242, XR-2243
Async to Sync Converter	XR-2125, XR-2124, XR-2135
Audio Amplifier/Preamp	XR-4560, XR-5532, XR-5534
Audio Level Detector	XR-2276
Automatic Gain Control (AGC)	XR-2208, XR-2216, XR-2228, XR-13600

B

Bar Graph Display	XR-2276, XR-2277, XR-2278, XR-2279,
Battery Charger Timing	XR-2242, XR-2243
Battery Operated Instruments (Low-Power)	
Timing	XR-L555, XR-L556, XR-2243
Tone Detection	XR-L567
Bit-Pattern Generation	XR-2240

C

Carrier Detection (See AM and Tone Detection)	
High-Frequency (>1 MHz)	XR-215/XR-2228
Low-Frequency (<1 MHz)	XR-567A, XR-2211, XR-L567
Low-Power	XR-L567
Carrier-Tone Transceiver	XR-2567
Clock Generation (See Oscillators)	
Low-Frequency (<1 MHz)	XR-555, XR-2209, XR-2242
Low-Power	XR-L555, XR-L556, XR-2243
High-Frequency (>1 MHz)	XR-205
Phase Locked	XR-215, XR-2212, XR-2213
Clock Extraction	
Phase Locked	XR-210, XR-215, XR-2212, XR-2213
PCM Signal Clock	XR-C262, XR-C277
Clock Pattern Generation	XR-2240
Clock Synchronization	
High-Frequency (>1 MHz)	XR-210, XR-215
Low-Frequency (<1 MHz)	XR-2212, XR-2213
Compandor(Speech/Data)	XR-2216
Current-to-Frequency Converter	XR-2206, XR-2207, XR-2209
Current Drive	XR-2247, XR-2247A

D

Darlington Arrays (High-Current, High-Voltage)	XR-2200, XR-2201, XR-2202, XR-2203, XR-2204, XR-2001, XR-2002, XR-2003, XR-2004, XR-2011, XR-2012, XR-2013, XR-2014
Data Buffer	XR-2124, XR-2125, XR-2135

E

F

T

U

V

W

EXAR

Section 12—Quality Assurance and Reliability

EXAR'S COMMITMENT TO QUALITY AND RELIABILITY

First the terms Quality and Reliability must be defined.

Quality is conformance to requirements, i.e., meets specification requirements, adheres to procedure, etc. Quality must be measurable, thus it must be defined in measurable terms. Quality is measurable in many ways, a common one being Average Outgoing Quality Level (AOQL) generally stated in Parts Per Million (PPM).

Reliability is length of time product conforms. This is also a measurable quantity and is generally expressed as Mean Time Between Failures (MTBF) or Failures in Time (FIT). The relationship between MTBF (or failure rate) and time is illustrated in the bathtub curve.

EXAR is committed to achieving high levels of Quality and Reliability. To achieve this goal, we design and build quality and reliability into all our products. Each EXAR employee is committed to assuring this goal by diligent adherence to the quality first concept.

EXAR continuously monitors the Quality and Reliability levels of its products via AOQL sampling plans and periodic reliability testing programs. Monitoring alone is not sufficient. At EXAR any reject discovered at the monitoring level is scrutinized by extensive failure analysis and corrective action taken to prevent recurrence.

Reliability, primarily a function of device design, fabrication, and assembly methods and materials, cannot be tested into ICs. However, EXAR proposes combinations of specific environmental tests designed to accelerate failures of marginal devices, thereby eliminating early life failures. By choosing the desired combination of environmental tests, you can choose the reliability level that fits your need.

Benefits Every Step of the Way

Devices that undergo the specifically designed environmental tests begin paying dividends the moment you receive them and continue doing so for the life of the system.

Your circuit board testing is also reduced along with your test equipment costs. Since more of the components on a board are higher quality, the quality of the entire board is better.

There is less board rework for the same reason.

Even traditional burn-in can be reduced substantially, improving the flow of work in process.

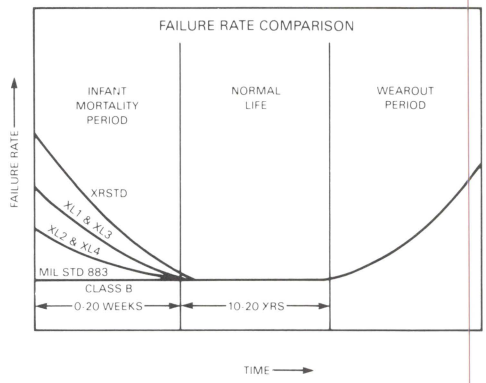
Finally, performance in the field is improved. Fewer field failures result in fewer service problems and, more important, fewer dissatisfied customers.

A Modest Investment

EXAR's Standard and Excel™ screening methods are virtually identical to those used in compliance with military specifications.

Yet, because there is no extensive military documentation involved, EXAR can pass these savings on to you.

The result is that you receive almost mil-grade parts at lower prices.



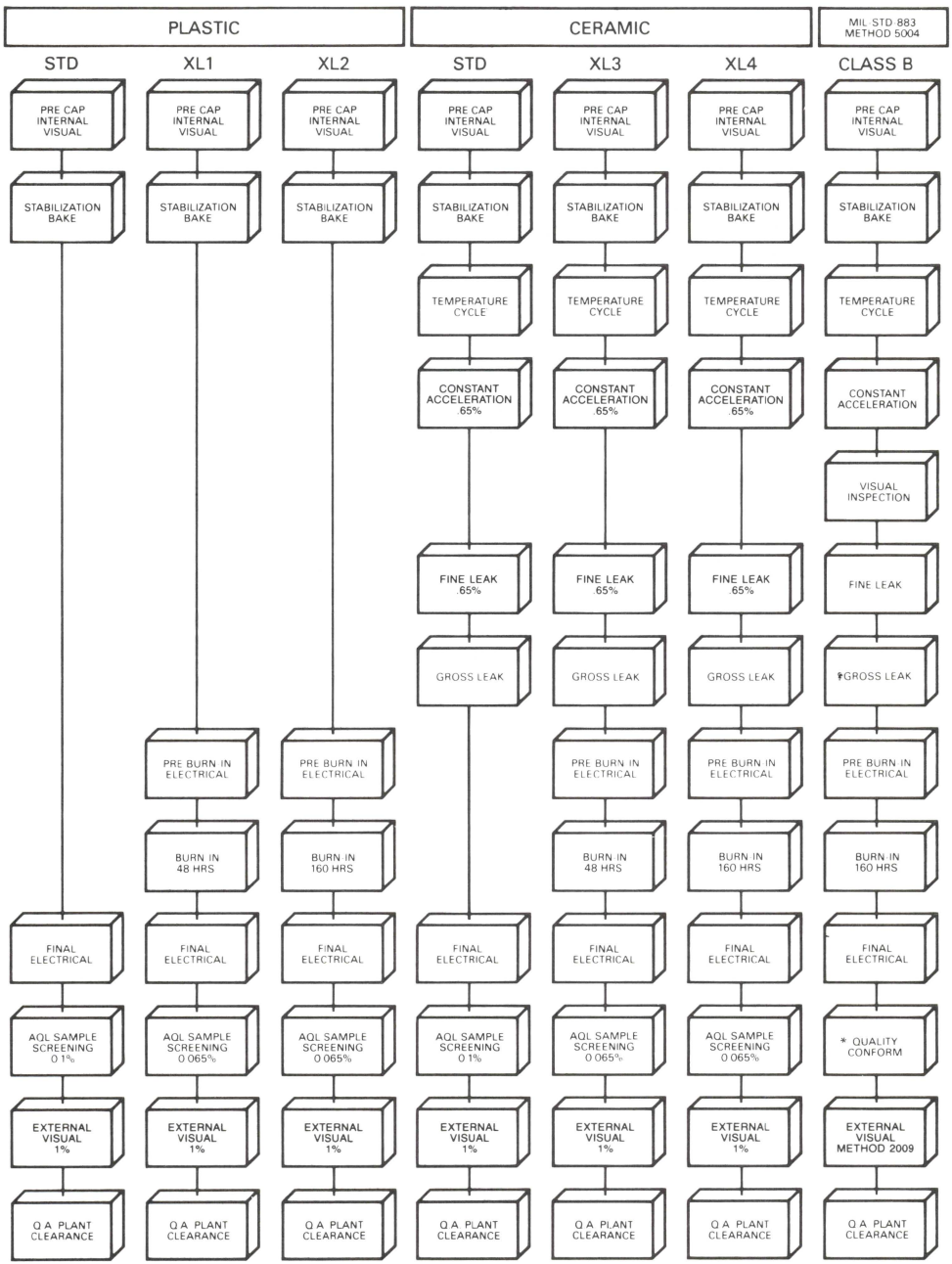
EXAR's Reliability Program Summary

EXAR's reliability program is designed for the evaluation of high-density complex integrated circuits which require greater attention than simple conventional reliability tests. EXAR believes in producing excellent reliability (XR) by building the quality and reliability into the products. Once raw silicon is transferred to a complex integrated circuit, through quality conscious people, it needs to satisfy the increasingly stringent requirement of the QA Reliability Department to ensure that the products demonstrate the acceptable level of quality and reliability.

Reliability Testing

Reliability is defined as "the probability of an item to perform a required function under stated conditions for a stated period of time." EXAR performs the reliability testing on a sample of 100 pieces and the flow being used is detailed in Table 1. There are monitoring programs at EXAR to assure high product reliability.

Based on the data available from reliability experiments, MTBF, and failure rate are computed using the Arrhenius equation. Results of recently completed reliability experiments are summarized in Table 2.



NOTE: ALL OPERATION ARE 100% UNLESS OTHERWISE SPECIFIED

*QUALIFICATION & QUALITY CONFORMANCE PROCEDURES

Screen	Mil-Std, Method 5005, Class B Test Conditions	Requirement
Group A	Final electrical repeated on sampling basis (sub group 1 thru 11)	Each sublot sampling basis.
Group B	Package construction & function related tests (dimensions, resistance to solvent, solderability, int. visual, bond strength, seal & EDS)	Each sublot sampling basis except subgroup 6. Subgroup 8 only for initial qualification.
Group C	Die related tests (life test, temp cycling, const. acceleration & seal tests)	Performed every 3 month interval for each micro circuit group.
Group D	Package related tests (dimensions, lead integrity, seal tests, thermal shock, temp. cycle, moisture test, mechanical shock, vibration, const. acceleration & salt atmosphere)	Performed every 6 month interval for each package type.

Table 1

Test	Sample Size	Duration	Condition
Stabilization Bake	100	24 hours	150°C, Method 1008, Cond.C
Temperature Cycling	100	10 cycles	−65°C to +150°C, Method 1010, Cond. C
Acceleration*	100	1 minute	30,000 Gs, Y_1 axis, Method 2001, Cond. E
Fine Leak*	100	2 hours	Method 1014, Cond. A
Gross Leak*	100		Method 1014, Cond. C
Electrical Test	100		Y25°C
Burn-in	100	160 hours	125°C Method 1015, Cond. C
Electrical Test	100		25°C
Burn-in	100	340 hours	125°C, Method 1015, Cond. C
Burn-in	100	500 hours	125°C, Method 1015, Cond. C
Electrical Test	100		25°C
Burn-in	100	1000 hours	125°C, Method 1015, Cond. C
Electrical Test	100		25°C
Burn-in	100	1000 hours	125°C, Method 1015, Cond. C
Electrical Test	100		25°C

* Not applicable to plastic encapsulated devices.

Table 2

Product Family	Sample Size	Number of Failures	Degrees of Freedom	χ^2 95%	χ^2 99%	MTFB in Billion Hrs. 95%	MTFB in Billion Hrs. 99%	Failure Rate in FITS 95%	Failure Rate in FITS 99%
Linear									
26V Proc.	100	0	2	5.99	9.21	1.76	1.15	0.56	0.87
36V Proc.	100	0	2	5.99	9.21	1.76	1.15	0.56	0.87
75V Proc	100	0	2	5.99	9.21	1.76	1.15	0.56	0.87
Digital									
Bipolar/I^2L	100	1	4	9.49	13.3	1.11	0.79	0.89	1.25
CMOS	100	1	4	9.49	13.3	1.11	0.79	0.89	1.25

Summary: MTBF and Failure Rate based on following

Activation Energy = 1.0EV
T_A = $125°C, Junction Temperature = 150°C
Cumulative Duration = 3000 Hours per Cycle (5 interim electricals)
Confidence Level = 95%
Average MTBF = 1.50 Billion Hours
Average Failure Rate = 0.69 fits

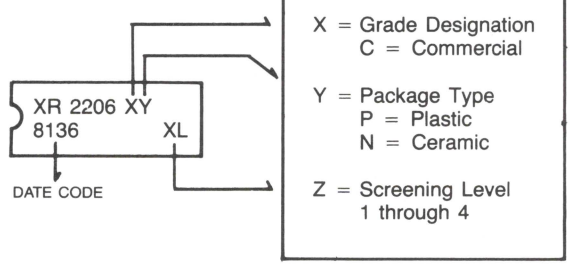
EXAR'S EXCEL™ PROGRAM

SCREENING	PLASTIC (P)		CERAMIC (N)		COMMENTS
	XL[1]	XL[2]	XL[3]	XL[4]	
Pre cap. Internal Visual	QCI 2006	Method 2010	QCI 2004	Method 2010 Cond. B	100%
Sta. Bake	6 hrs @ 175°C	6 hrs @ 175°C	6 hrs @ 175°C	6 hrs @ 175°C	100%
Temp. Cycling			−65°C to +150°C	−65°C to +150°C	10 Cycles 100%
Const. Accel.			30,000 gm Y_1 axis	30,000 gm Y_1 axis	.65% AQL
Fine Leak			.65% AQL	.65% AQL	.65%
Gross Leak			100%	100%	
Pre Burn-in Electrical	100%	100%	100%	100%	Per Device Spec
Burn-in	48 hrs	160 hrs	48 hrs	160 hrs	
Final Electrical	100%	100%	100%	100%	Per Device Spec
AQL Sample	.065%	.065%	.065%	0.65%	Mil Std 105 D
External Visual	Per XR Std	Per XR Std	Per XR Std	Per XR Std	100%
QA Plant Clearance	100%	100%	100%	100%	

PRICING

CONSULT FACTORY

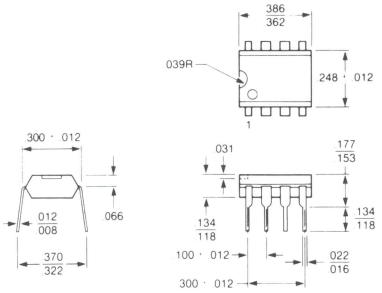
MARKING EXAMPLE



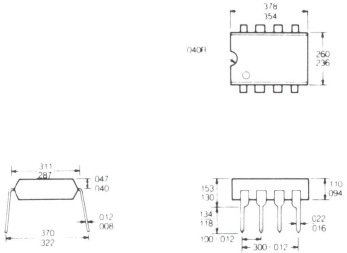
EXAR

Section 13—Packaging Information

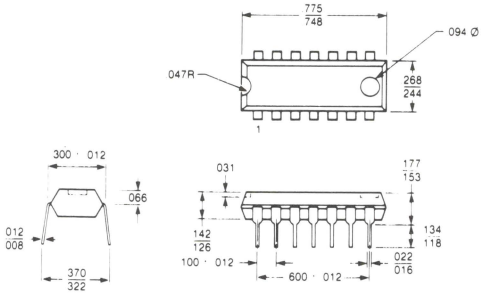
Package Information
(Plastic)



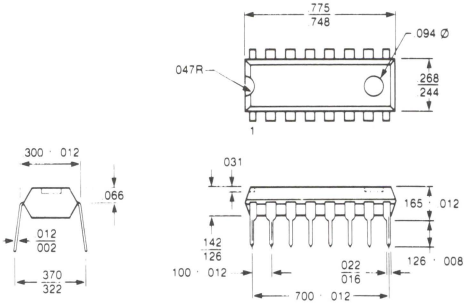
8 PIN MOLDED PLASTIC DIP



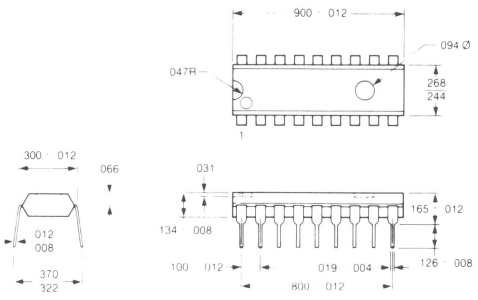
8 PIN MOLDED PLASTIC DIP (JAPAN)



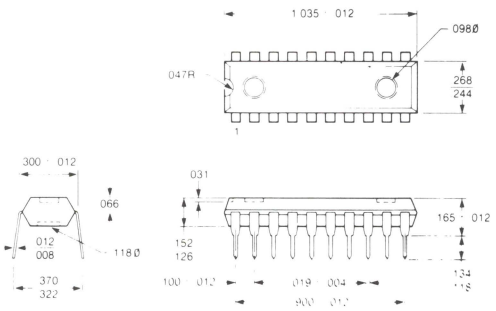
14 PIN MOLDED PLASTIC DIP



16 PIN MOLDED PLASTIC DIP

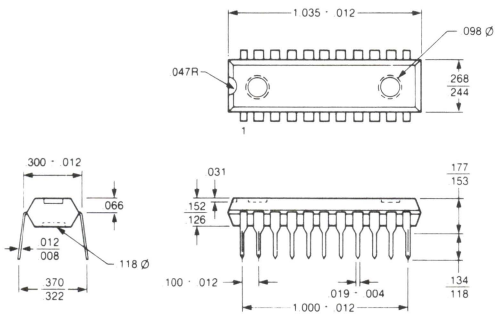


18 PIN MOLDED PLASTIC DIP

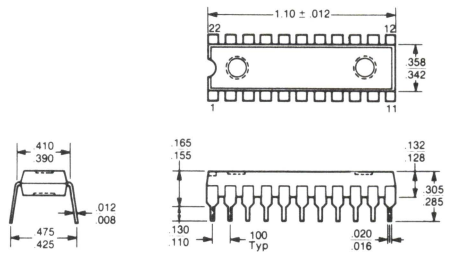


20 PIN MOLDED PLASTIC DIP

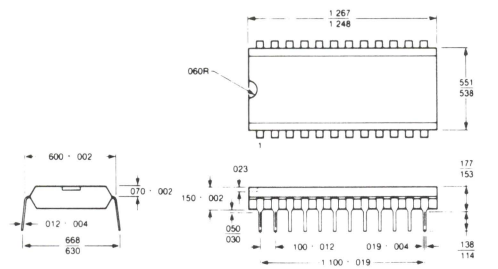
Package Information
(Plastic)



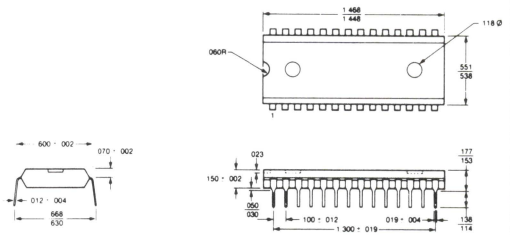
22 PIN MOLDED PLASTIC DIP



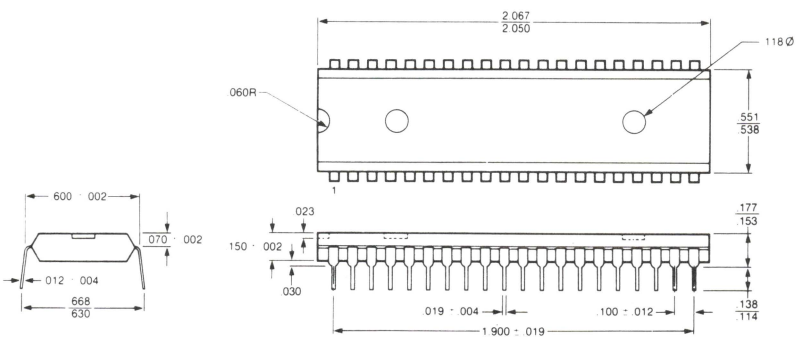
22 PIN MOLDED PLASTIC DIP
(400 MILS WIDTH)



24 PIN MOLDED PLASTIC DIP



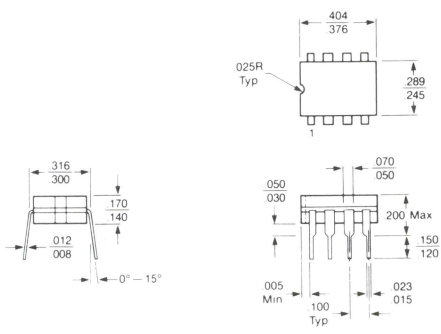
28 PIN MOLDED PLASTIC DIP



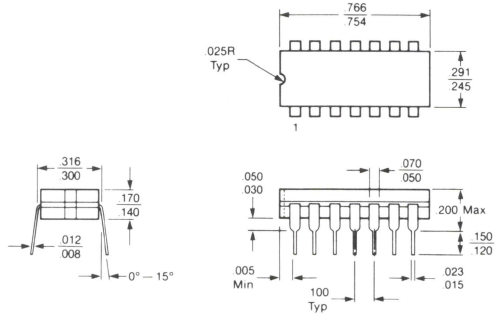
40 PIN MOLDED PLASTIC DIP

13

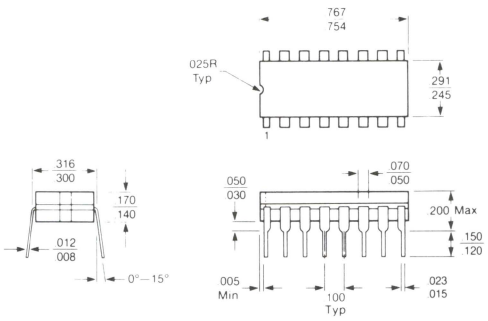
Package Information
(Cerdip)



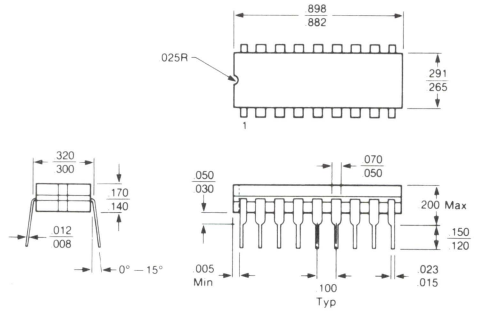
8 PIN CERAMIC CAVITY DIP



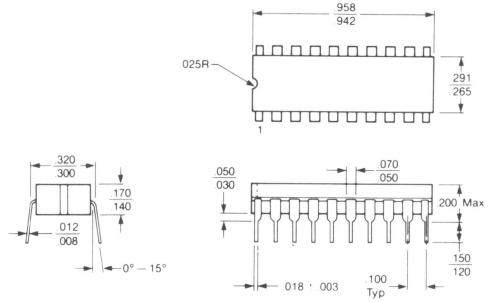
14 PIN CERAMIC CAVITY DIP



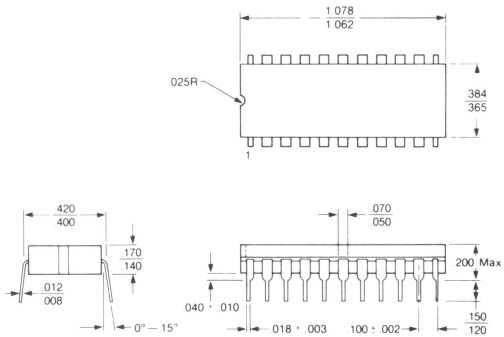
16 PIN CERAMIC CAVITY DIP



18 PIN CERAMIC CAVITY DIP

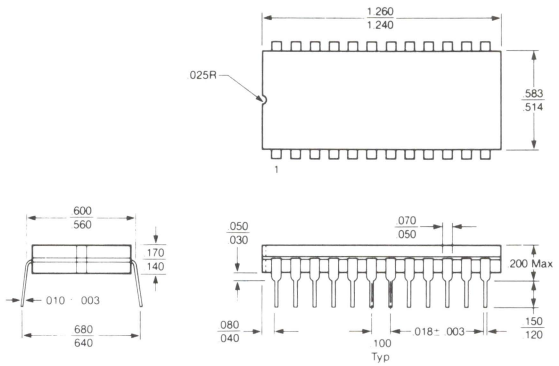


20 PIN CERAMIC CAVITY DIP

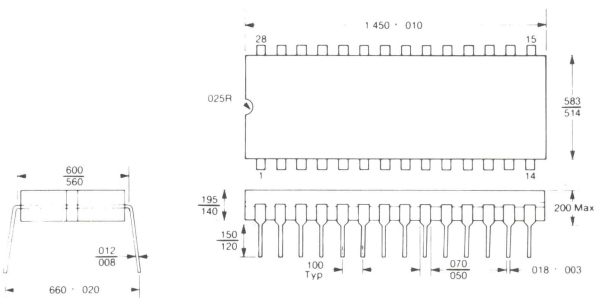


22 PIN CERAMIC CAVITY DIP

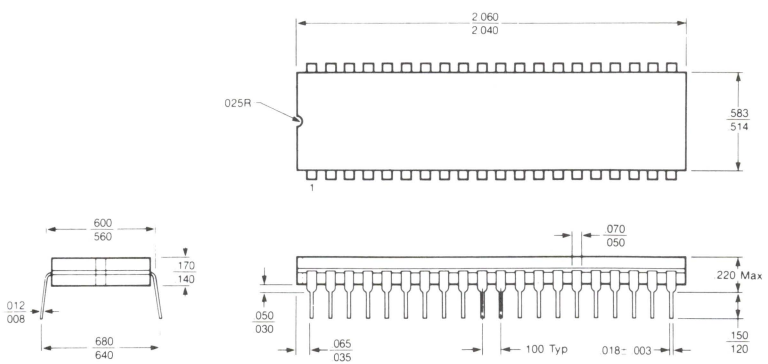
Package Information
(Cerdip)



24 PIN CERAMIC CAVITY DIP



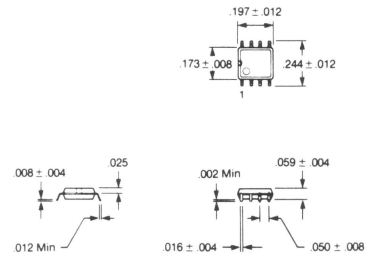
28 PIN CERAMIC CAVITY DIP



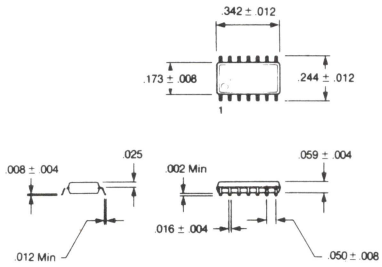
40 PIN CERAMIC CAVITY DIP

13

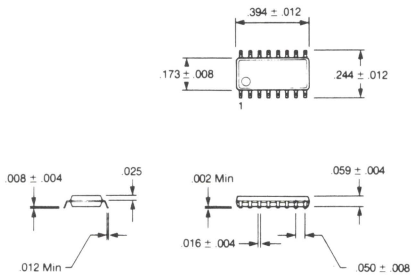
Package Information
(Plastic Small Outline)



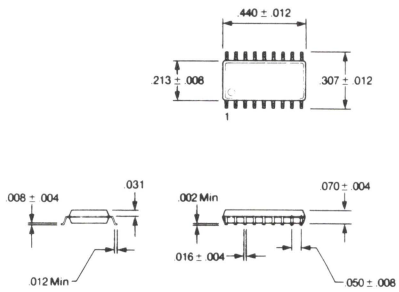
8 PIN S.O.T. PACKAGE (M.D.P.)



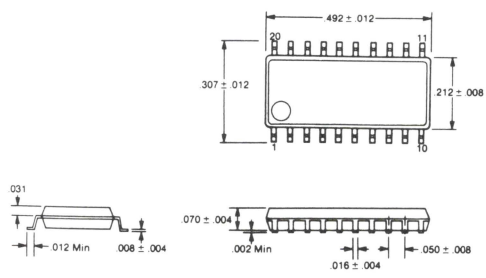
14 PIN S.O.T. PACKAGE (M.D.P.)



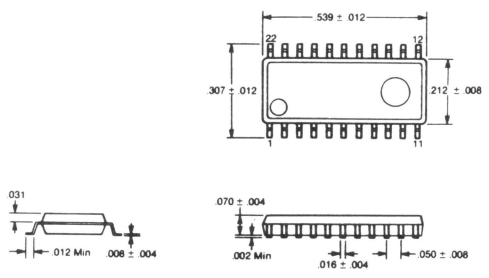
16 PIN S.O.T. PACKAGE (M.D.P.)



18 PIN S.O.T. PACKAGE (M.D.P.)

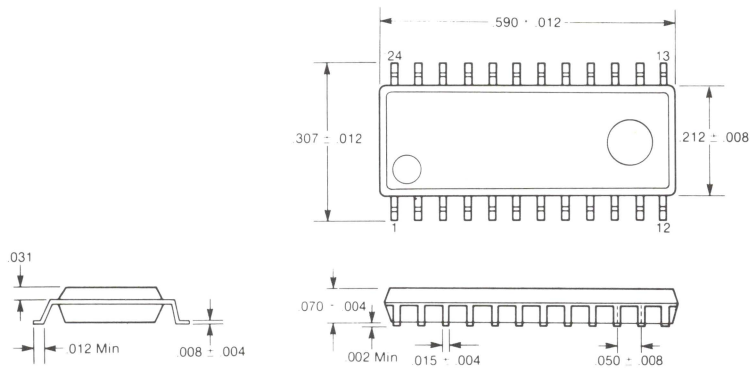


20 PIN S.O.T. PACKAGE (M.D.P.)

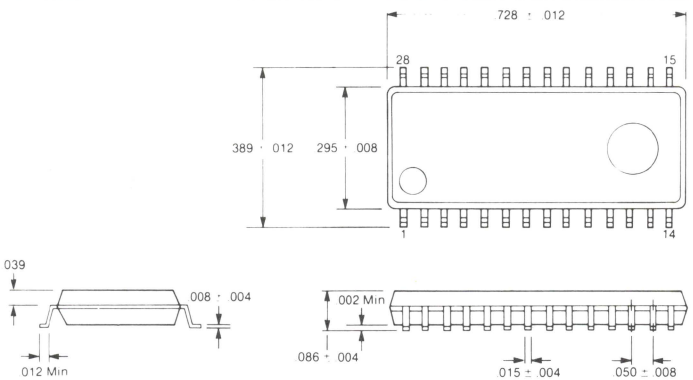


22 PIN S.O.T. PACKAGE (M.D.P.)

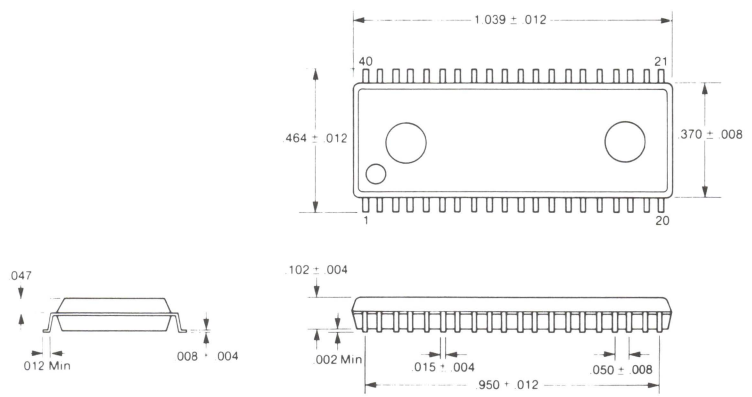
Package Information
(Plastic Small Outline)



24 PIN S.O.T. PACKAGE (M.D.P.)

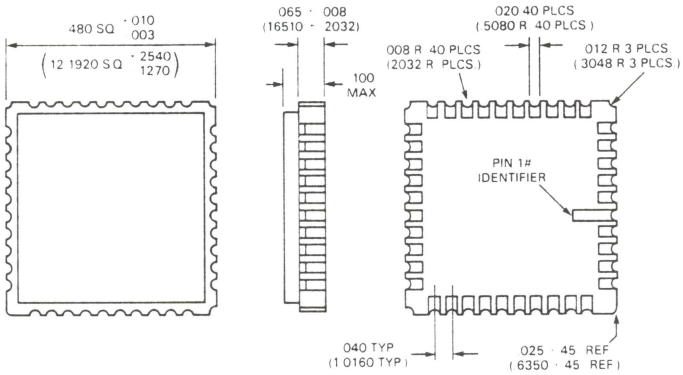


28 PIN S.O.T. PACKAGE (M.D.P.)

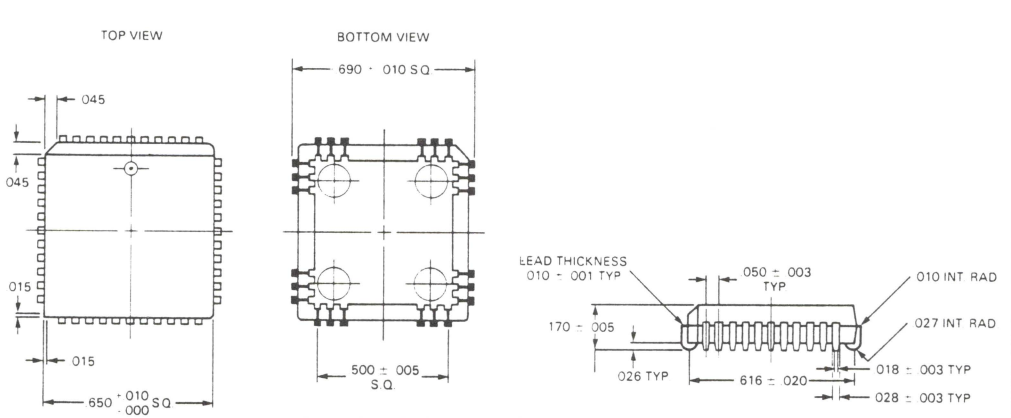


40 PIN S.O.T. PACKAGE (M.D.P.)

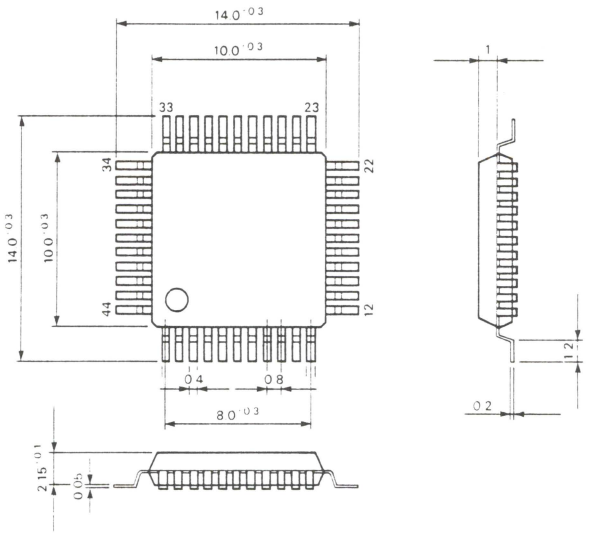
13



40 PIN LEADLESS CHIP CARRIER



44 PIN PLASTIC LEADED CHIP CARRIER



40 PIN QUAD PACKAGE

Monolithic Chips for Hybrid Assemblies

The major performance characteristics of Exar products are also available in chip form. All chips are 100% electrically tested for guaranteed dc parameters at 25°C, and 100% visually inspected at 30× to 100× magnification using Exar's standard visual inspection criteria or MIL-STD-883, Method 2010, depending on the individual customer requirements. Each chip is protected with an inert glass passivation layer over the metal interconnections. The chips are packaged in waffle-pack carriers with an anti-static shield and cushioning strip placed over the active surface to assure protection during shipment. All chips are produced on the same well-proven production lines that produce Exar's standard encapsulated devices. The Quality Assurance testing of dice is provided by normal production testing of packaged devices.

FEATURES

Guaranteed dc Parameters at 25°C
100% Visual Inspection
Care in Packaging
100% Stabilization Bake (Wafer Form)

CHIPS IN WAFER FORM

Probed and inked wafers are also available from Exar. The hybrid microcircuit designer can specify either scribed or unscribed wafers and receive a fully tested silicon wafer. Rejected die are clearly marked with an ink dot for easy identification in wafer form.

ELECTRICAL PARAMETERS

Probing the IC chips in die form limits the electrical testing to low-level dc parameters at 25°C. These dc parameters are characteristic of those parameters contained on the individual device data sheet and are guaranteed to an LTPD of 10%.

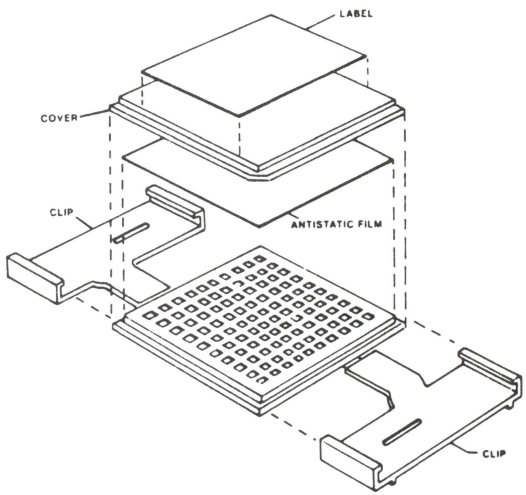
The ac parameters, which are similar to those in the standard Exar device data sheets, have been correlated to selected dc probe parameters.

HANDLING PRECAUTIONS AND PACKAGING OPTIONS

Extreme care must be used in the handling of unencapsulated semiconductor chips or dice, to avoid damage to the chip surface. Exar offers the following two handling or packaging options for monolithic chips supplied to the customer:

Cavity or Waffle Pack: The dice are placed in individual compartments of the waffle pack (see figure). The plastic snap clips permit inspection and resealing

Wafer Pack: The entire wafer is sandwiched between two pieces of mylar and vacuum sealed in a plastic envelope.



Typical Cavity Pack (Waffle Pack)

13

The Benefits of Surface Attachment

Surface mounting identifies a technique for mounting ICs and other devices of like geometries in a low-profile package on the surface of a printed-circuit board. These devices are today known as SO (Small Outline) devices. Unlike plated-through-hole technology in which the leads of devices are inserted in holes perpendicular to the board surface, the leads of the SO devices solder to circuit board pads that lie on the board surface.

Both the surface area and the profile (height of the package above the board) are reduced. As an example, a 14-pin SO package has an overall height of .067-inch, whereas a conventional DIP is .177-inch high. The SO package leads are spaced on 0.50-inch centers, rather than 0.100-inch centers, as is the case with the traditional DIP package.

Other benefits include:

- **Reduces Assembly Costs**–By utilizing the new pick-and-place equipment, board assembly can be fully automated. Components are available on reels which dramatically reduce storage and handling costs.

- **Smaller Boards**–Because the SO package sizes are approximately 30% to 50% smaller in size than their DIP counterparts, printed-circuit boards can be reduced in size by 50% or more.

- **Less Complex Circuit Boards**–Since SO-packaged ICs mount on the surface, rather than in relatively large (.035-inch) plated-through holes, both rigid and flexible circuit boards require fewer and smaller holes. Where interconnections are required between layers, vias, typically 0.018-inch in diameter, are employed. This enables designs to employ fewer circuit board layers and hence less costly circuit boards per square inch.

- **Higher Performance**–Because boards are smaller and IC lead inductances are less, distributed reactances are reduced and signal paths are shortened. This raises performance in high-speed, digital systems, and in r-f systems.

- **Cost-Effective On-Shore Assembly**–Because the SO components enhance the appeal of on-shore, automated assembly, they can eliminate the severe logistic demands and extended cycle times of off-shore assembly.

Typical Surface Mounting Applications...
In consumer products where compact assemblies are essential–hand-held cameras, toys, audio equipment. In automotive equipment...engine and climate controls.

In Telecommunications...modems, active filter networks, speech processors, PBXs and voice-recognition units.

In Computer Peripherals...Disk Drives, Winchester Drives, and thermal and impact printers.

Exar's Surface-Mountable Package Devices Exhibit Extraordinary Reliability

Exar's SO package, using a unique nitride passivation, has shown itself able to survive highly stressful environmental conditions. Which is why Exar's SO devices are as reliable as any 0.300-inch spaced, conventional DIP.

Here is some typical test data:

Reliability Data

Test	Condition	Sample Size	XR2004 Rejects	XR3403 Rejects	XR4558 Rejects
External Visual	Per MIL STD 883, method 2009.	200	0	0	0
High Temp. Storage	48 Hr. at 150°C	200	0	0	0
Temperature Cycling	10 cycles– −65°C to 150°C per MIL STD 883, method 1010, condition C.	200	0	0	0
Electrical Tests	Per Exar Data Sheet.	200	0	0	0
Lot Sample Burn-in	48 Hr. Max. Elect. Tests per MIL STD 883, method 1015 at 125°C for 48 hours; end point electrical tests per Exar Data Sheet.	55	0	0	0
Autoclave (Pressure Cooker)	100 Hr. 121°C, 15 p.s.i.g.; electrical tests per Exar Data Sheet.	25	0	0	0
Steady State Life	1000 Hr. T_A = 125°C per MIL STD 883, method 1015. (See Note)	55	1	0	0
Biased Moisture Life	1000 Hr. T_A = 85°C, R.H. = 85%; electrical tests per Exar Data Sheet.	55	0	0	0

*Note: One electrical failure at post burn-in after 100 hours.

Products Available in Surface-Mount Packages

		Package
Display Drivers		
XR-6118*	Fluorescent Display Driver	SO-18
Disk Drive ICs		
XR-117	Consult Factor	
XR-2247	Floppy Disk Write Amplifier	SO-22
XR-3470A/B*	Floppy Disk Write Amplifier	SO-18
XR-3448	Single Chip Floppy Disk Read/Write Amplifier	QFP-32
XR-3449	Single Chip Floppy Disk Read/Write Amplifier	QFP-32
XR-3471	Floppy Disk Write Amplifier	SO-20
Voltage Regulators		
XR-494/† XR-495	Pulse-Width Modulating Regulator	SO-18
Tone Decoders/Phase-Locked Loops		
XR-567*	Monolithic Tone Decoder	SO-8
XR-L567	Micropower Tone Decoder	SO-8
Line Drivers/Receivers		
XR-1488*	Quad Line Driver	SO-14
XR-1489*	Quad Line Receiver	SO-14
Instrumentation ICs		
XR-8038	Precision Waveform Generator	SO-14
XR-8038A	Precision Waveform Generator	SO-14
Timing Devices		
XR-320	Monolithic Timing Circuit	SO-14
XR-555*	Timing Circuit	SO-8
XR-L555	Micropower Timing Circuit	SO-8
XR-556*	Dual Timer	SO-14
Operational Amplifiers		
XR-082*†	Dual Bipolar JFET Operational Amplifier	SO-8
XR-083	Dual Bipolar JFET Operational Amplifier	SO-14
XR-3403*	Quad Operational Amplifier	SO-14
XR-4136	Quad Operational Amplifier	SO-14
XR-4202	Programmable Quad Operational Amplifier	SO-16
XR-4558*	Dual Operational Amplifier	SO-8
XR-4741	Quad Operational Amplifier	SO-14
XR-4739	Dual Low-Noise Operational Amplifier	SO-14
XR-13600	Dual Operational Transconductance Amplifier	SO-16
XR-4560	Dual Low-Noise Operational Amplifier	SO-8
Modems/Filters		
XR-2120	PSK Modem Filter – 212A	QFP-44
XR-2121	Bell 212A Modulator	QFP-44
XR-2122	Bell 212A Modulator	QFP-44
XR-2125	Bell 212A Data Buffer	QFP-44
XR-2126	Bell 212A/V.22 Modem Filter	QFP-44
XR-2127	Bell 212A/V.22 Modem Filter	QFP-44
XR-2128	Bell 212A/V.22 Modem Filter	QFP-44
XR-2129	Bell 212A/V.22 Modem Filter	QFP-44

		Package
Printer Drivers		
XR-2200	Hammer Driver	SO-14
Voltage-to-Frequency Converters		
XR-4151	Voltage-to-Frequency Converter	SO-8
Miscellaneous ICs		
XR-2001	High Voltage, High Current Darlington	SO-16
XR-2002	Transistor Arrays	SO-16
XR-2003	Transistor Arrays	SO-16
XR-2004	Transistor Arrays	SO-16

Master-Chip Semi-Custom ICs		
XR-A100	20V, 260 Components	SO-8,14,16,18
XR-B100	20V, 300 Components	SO-8,18
XR-C100A	20V, 110 Components	SO-8,14,16
XR-D100	36V, 193 Components	SO-8,18
XR-E100	20V, 187 Components	SO-8,18,20
XR-F100	20V, 440 Components	SO-22,24,28
XR-G100	20V, 309 Components	SO-8,18,20
XR-H100	20V, 378 Components	SO-8,18,20
XR-J100	20V, 170 Components	SO-8,14,16,18,20
XR-L100	20V, 408 Components	SO-18,20,22,24
XR-M100	20V, 812 Components	None
XR-V100	36V, 503 Components	SO-22,24,40
XR-W100	36V, 850 Components	None
XR-X100	75V, 230 Components	SO-22,24,28,40

† Pin Out Charge

* Devices currently available from sample stock.

Package Dimensions

The following packages are available from EXAR. Please consult the factory for additional information.

8 Pin SO	20 Pin SO	40 Pin SO
14 Pin SO	22 Pin SO	32 Pin QFP
16 Pin SO	24 Pin SO	44 Pin QFP
18 Pin SO	28 Pin SO	64 Pin QFP

Surface-Mounting Manufacturing Techniques...

Component Handling
Exar can supply ICs in both antistatic tubes and various tape and reel options, including EIA standard RS-481 specified taping (see bibliography page 7). This taping is compatible with automated assembly equipment such as Panasonic's Panaplace "M", Universal Instrument's Onserter, and adaptable to many others such as Dynapert, Zevatech, Celmacs, Fuji, and MCT.

Component Placement
Typically pick-and-place equipment uses a vacuum mechanism to hold the device on its vacuum placement probe. Placement equipment can place within ±0.0005 inch from a fixed x-y position. Typical equipment places 800 to 8000 components per hour with some equipment placing surface-mounted devices at even much higher rates.

A standard technique is to tack the IC in place with solder paste, then dried in order to secure position prior to wave soldering.

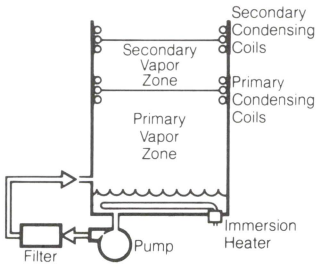
In practice, alignment can be off slightly due to the 'self-aligning' feature. For when the heat melts the solder, the leads are pulled laterally as well as down onto the pads.

Component Soldering
The SO package is designed primarily for reflow soldering—rather than wave soldering. Reflow techniques include:

- Infrared
- Hot Air
- Vapor Phase

Best results are obtained when the same solder is used on the leads and on the substrate metalization. Printed-circuit boards can be metalized by dipping in a solder bath, or by screening solder paste and then reflowing. Paste thickness should be typically 0.006 to 0.008 inch (150 to 200 micrometers) thick.

Batch Type VPS System



A Glossary of Surface Attachment Terms

Aspect Ratio
The ratio of the circuit board thickness to the smallest hole diameter.

Barrel
The cylinder formed by plating through a drilled hole.

Fluorinated Carbon
A fluid which when vaporized behaves as a highly-effective heat-transfer medium in vapor-phase soldering.

Hot-Air Soldering
A typical hot-air system employs a preheat and a soldering air jet. Preheat usually occurs at 110°C, followed by soldering at 260°C. Travel is typically 10 cm/minute (3.93 inches/minute). Air pressure must be monitored to make sure a device is not blown out of position or that molten solder does not bridge adjoining traces.

Infrared
Basically an oven technique for reflow soldering.

Mil
One-thousandth (0.001) of an inch.

Multilayer Printed-Circuit Board
A printed circuit board consisting of three or more conducting circuit planes separated by insulating material and bonded together with internal and external connections to each level of the circuitry as required.

Plated-Through Hole
A hole with the deposition of metal (usually copper) on its sides to provide electrical connections between conductive patterns at the levels of a printed circuit board.

Reflow Soldering
A technique employed in surface attachment to solder devices to printed circuit boards. It requires that leads and pads of boards already have solder in place.

SMD
Surface Mount Device—(same as SO)

SO Package
Small Outline Package (See SMD)

Solder Paste
Finely-powdered solder and flux suspended in a binder.

Solder Resists
Coatings which mask and insulate portions of a circuit pattern where solder is not desired.

Vapor-Phase Soldering
A technique employed in surface attachment technology to reflow solder devices to the foil pads on the printed circuit board. Heat is conducted through a gas, typically a boiling inert fluid usually 215°C blanketed with a vapor blanket to prevent loss of the inert fluid. This technique is significantly faster than other methods.

Via
A plated-through hole used as a through connection, but in which there is no intention to insert a component lead.

Wave Soldering
The traditional technique for soldering components to circuit boards. The bottom surface of the boards travels across the surface of a reservoir of molten solder and the solder is drawn up into each plated-through hole by capillary action.

Wetting
The formation of a relatively uniform, smooth, unbroken and adherent film of solder to a base material.

EXAR

Section 14—Authorized Sales Representatives and Distributors

Authorized Sales Representatives

ALABAMA
REP INCORPORATED
PO BOX 4889
11535 GILLELAND ROAD
HUNTSVILLE, AL 35815
205/881-9270
TWX 810-726-2102

ALASKA
(CALL EXAR DIRECT)

ARIZONA
SUMMIT SALES
7802 E. GRAY ROAD
SCOTTSDALE, AZ 85260
602/998-4850
TWX 910-950-1283

CALIFORNIA (Southern)
HARVEY KING, INC.
6393 NANCY RIDGE DRIVE
SAN DIEGO, CA 92121
619/587-9300
TWX 910-380-3305

LANDA/MINYARD, INC.
1618 COTNER AVENUE
LOS ANGELES, CA 90025
213/879-0770
TWX 910-342-6343

LANDA/MINYARD, INC.
1616 EAST 4TH ST., STE. 280
SANTA ANA, CA 92701
714/543-7805

CALIFORNIA (Northern)
TRIPAR ASSOCIATES
SUITE C204
1580 OAKLAND ROAD
SAN JOSE, CA 95131
408/280-5744

COLORADO
CANDAL INC.
1536 COLE BLVD., STE. 145
GOLDEN, CO 80401
303/233-0155
TLX 703771 CANDAL UD

CONNECTICUTT
PHOENIX SALES
386 MAIN STREET
RIDGEFIELD, CT 06877
203/438-9644
TWX 710-467-0662

DELAWARE
(SEE MARYLAND)

FLORIDA
DONATO & ASSOC., INC.
C/O MR. CHARLIE MITCHELL
9560 SHADOW WOODJ COURT
CORAL SPRING, FL 33065
303/755-0702

DONATO & ASSOC., INC.
5401 KIRKMAN RD., STE. 785
ORLANDO, FL 32819
305/352-0727
EASY LINK 62897593

DONATO & ASSOC., INC.
535 HOLLOW RIDGE ROAD
PO BOX 1560
PALM HARBOR, FL 33563
813/785-3327

DONATO & ASSOCIATES, INC.
ATTN: WOODY WOODRUFF
2027 LITTLE NECK ROAD
CLEARWATER, FL 33515

GEORGIA
REP INCORPORATED
1944 NORTHLAKE PKWY., STE. 1
TUCKER, GA 30084
404/938-4358
TWX 810-766-0822

HAWAII
(CALL EXAR DIRECT)

ILLINOIS (Northern)
JANUS, INC.
650 DEVON, STE. 165
ITASCA, IL 60143
312/250-9650
TWX 510-600-3070
FAX 312/350-8761

ILLINOIS (Southern)
(SEE MISSOURI)

INDIANA
(SEE OHIO)

IOWA
(SEE MISSOURI)

KANSAS
DESIGN SOLUTIONS, INC.
10000 WEST 75TH STR., STE. 200
SHAWNEE MISSION, KS 66204
913/677-4774

KENTUCKY
(SEE OHIO)

LOUISIANA
(SEE TEXAS)

MAINE
(SEE NEW HAMPSHIRE)

MARYLAND
COMPONENT SALES
106 OLD COURT ROAD
SUITE 204
BALTIMORE, MD 21208
301/484-3647
TWX 710-862-0852

MICHIGAN
R.P. URBAN & ASSOCIATES
2335 BURTON ST., SE
PO BOX 7386
GRAND RAPIDS, MI 49510
616/245-0511
TWX 810-273-6992

PENNSYLVANIA (East)
SUNDAY-O'BRIEN
15 POTTER STREET
HADDONFIELD, NJ 08033
609/429-4013

PENNSYLVANIA (West)
(SEE OHIO)

MINNESOTA
COMPONENTS GROUP CORP.
45 GROVELAND TERRACET
PO BOX 3978
MINNEAPOLIS, MN 55403
612/374-1250

MISSISSIPPI
(SEE ALABAMA)

MISSOURI
DESIGN SOLUTIONS, INC.
1243 HANLEY INDUSTRIAL COURT
ST. LOUIS, MO 63144
314/961-7170

MONTANA
(SEE COLORADO)

NEBRASKA
(SEE MISSOURI)

NEVADA
(SEE CALIFORNIA, NO.)

NEW HAMPSHIRE
ACCESS SYSTEMS CORP.
7C TAGGART DRIVE
NASUA, NH
603/888-8160
TWX 710-228-1769

NEW JERSEY (Northern)
(SEE NEW YORK CITY)

NEW JERSEY (Southern)
SUNDAY - O'BRIEN.
15 POTTER STREET
HADDONFIELD, NJ 08033
609/429-4013

NEW MEXICO
SYN TECH
8016 A ZUNI ROAD, S.E.
ALBUQUERQUE, NM 87108
505/266-7951

NEW YORK (Upstate)
QUALITY COMPONENTS
3343 HARLEM ROAD
BUFFALO, NY 14225
716/837-5430
TWX 910-380-2126

QUALITY COMPONENTS
116 E. FAYETTE STREET
MANILUS, NY 13104
315/682-8885
TWX 910-997-1313

NEW YORK CITY
TRIONIC ASSOCIATES, INC.
320 NORTHERN BLVD.
GREAT NECK, NY 11021
516/466-2300
TWX 510-223-0834

NORTH CAROLINA
ZUCKER ASSOCIATES, INC.
PO BOX 19868
RALEIGH, NC 27619
919/782-8433
TWX 510-928-0513

OHIO
APPLIED DATA MANAGEMENT
435 DAYTON STREET
CINCINNATI, OH 45214
513/579-8108
TLX 910-380-4167

OREGON
COMPONENTS WEST, INC.
15255 SW & 2ND AVENUE
SUITE A
TIGARD, OR 97223
503/684-1671
EASYLINK 62130040
FAX 503-639-5124

PENNYSLVANIA (Eastern)
SUNDAY-O'BRIEN
15 POTTER STREET
HADDONFIELD, NJ 08033
609/429-4013

RHODE ISLAND
(SEE NEW HAMPSHIRE)

TENNESSEE
REP INCORPORAED
113 S. BRANNER AVENUE
JEFFERSON CITY, TN 37760
615/475-4105
TWX 810-570-4203

TEXAS
TECHNICAL MARKETING
9027 NORTHGATE BLVD., STE. 140
AUSTIN, TX 78758
512/835-0064

TECHNICAL MARKETING
3320 WILEY POST ROAD
CARROLLTON, TX 75006
214/387-3601
TWX 910-860-5158

TECHNICAL MARKETING
2901 WILCREST DR., STE. 139
HOUSTON, TX 77042
713/783-4497
EASYLINK 510-100-9699

UTAH
CANDAL/ANDERSON
270 S. MAIN, STE. 108
BOUNTIFUL, UT 84010
801/292-8991

VERMONT
(SEE NEW HAMPSHIRE)

VIRGINIA
(SEE MARYLAND)

WASHINGTON
COMPONENTS WEST INC.
311-1 SHORELINE DRIVE
LIBERTY LAKE, WA 99019
509/255-6224
FAX 503-639-5124
EASYLINK 62130040

COMPONENTS WEST INC.
8175 166TH N.E.
REDMOND, WA 98052
206/885-5880
FAX 206-882-0642
EASYLINK 62130040

WASHINGTON D.C.
(SEE MARYLAND)

WEST VIRGINIA
(SEE OHIO)

WISCONSIN (Southeast)
JANUS, INC.
W 239N1690 BUSSE ROAD
WAUKESHA, WI 53188
414/542-7575
FAX 414/542-7634

WISCONSIN (West)
(SEE MINNESOTA)

WYOMING
(SEE COLORADO)

CANADA
CLARK-HURMAN ASSOCIATES
148 COLONNADE ROAD, STE. 205
NEPEAN, ONTARIO
CANADA K2E 7J5
613/727-5626

CLARK-HURMAN ASSOCIATES
37 GEORGE ST. N, STE. 404
BRAMPTON, ONTARIO
CANADA L6X 1R5
416/453-1118

REGIONAL SALES OFFICES
EXAR CORPORATION - West
4677 OLD IRONSIDES, 450, #117
SANTA CLARA, CA 95050
408/727-9788

EXAR CORPORATION - East
113 TERRACE HALL AVENUE
BURLINGTON, MA 01803
617/273-3927
TWX 710-332-8901

EXAR CORPORATION - Central
1920 THOREAU DRIVE, STE. 122
SCHAUMBURG, IL 60173
312/303-0063
TLX 253327
FAX 312-303-0067

EXAR CORPORATION - East/Central
23200 CHAGRIN BLVD., STE. 600
CLEVELAND, OH 44122
216/292-8106
TLX 4332054 HQCLV
FAX 216-464-7609

EXAR CORPORATION - Europe
ZILOG HOUSE
MOORBRIDGE ROAD
MAIDENHEAD, BUCKS., ENGLAND
44-628-783066

EXAR CORPORATION
Corporate Headquarters
750 PALOMAR AVENUE
SUNNYVALE, CA 94086
408/732-7970
TWX 910-339-9233
FAX 408-373-1635

EXAR

International Sales Representatives

AUSTRALIA
TOTAL ELECTRONICS
9 HARKER STREET
PMB NO. 250
BURWOOD 3125, AUSTRALIA
PHONE 288-4044
TLX 790-31261 TOTELEC AA

TRONIC BITS
PO BOX 371
MENTONE
VICTORIA 3194, AUSTRALIA
PHONE 587-6777
TLX 790-151479 TRON AA

BELGIUM
(SEE GERMANY)

BRAZIL
ROHM ELECTRONICS LTDA.
AL. REO NEGRO 1356
ALPHAVILLE, CEP 06400
BARUERI, SP, BRAZIL
TLX 11325275 UIEL BR

DENMARK
MER-EL A/S
VED KLAEDEBO 18
DK-2970 HORESHOLM
DENMARK
PHONE 02/57 10 00
TLX 855-37360 MEREL DK

FINLAND
YLEISELEKTRONIIKKA/OY
LUOMANNOTKO 6
0220 ESPOO 20
FINLAND
PHONE 90-452-1255
TLX 123212 YLEOY SF

FRANCE
VALDIX
ZA DES GODETS CE NO: 426
91374 VERRIERES LE BUISSON
FRANCE
PHONE 16/920-2606
TLX 690312 ALDIX F

GERMANY (WEST)
ROHM ELECTRONICS GMBH
D-4051 KORSCHENBROICH
MUEHLENSTRASSE 70
WEST GERMANY
PHONE 02161/61010-1
TLX 841/852330 ROHM D

GREECE
GENERAL ELECTRONICS LTD.
209 THIVON STREET
NIKEA
PIRAEUS 7, GREECE
PHONE 49 13595
TLX 863/212949 GELT GR

HONG KONG
ROHM ELECTRONICS LTD.
FLT. 13 3/F NEWPORT CTR.
116 MATAUKOK RD.
TOKWAWAN, KOWLOON, HONG KONG
PHONE 3-343481
TLX 780/37503 REHCL HYX

TEKTRON
1702 BANK CENTRE
636 NATHAN ROAD
KOWLOON, HONG KONG
TLX 38513 TEKHL HX
FAX 852 37234029
852 12340746

INDIA
FEGU
2584 WYANDOTTE STREET
MOUNTAIN VIEW
CA 94043 USA
PHONE 415/961-2380
TLX 345-599 FEGU ELEC PLA

ISRAEL
VECTRONICS LTD.
60 MEDINAT HAYEHUDIM ST.
PO BOX 2024
HERZLIA B 46120, ISRAEL
PHONE 052-556070
TLX 342579 VECO

ITALY
ELEDRA SPA
VIALE ELVEZIA, 18
20154 MILANO, ITALY
PHONE 34 93 041
TLX 843/332332 ELEDRA I

JAPAN
TOKYO ELECTRON LTD.
38 FL SHINJUKU NOMURA BLDG.
1-26-2 NISHI-SHINJUKU
SHINJUKU-KU TOKYO 160 JAPAN
PHONE 03-343-4411
TLX 781/2322240 LABTEL J

KOREA
HANARO CORPORATION
RM. 601, HANAM BLDG.
44-27 YOIDO-DONG, YOUNGDEUNGPO-KU
SEOUL 150, KOREA
PHONE 02/784-1144
TLX K26878 HANARO
FAX 02/784-0157

LATIN AMERICA
INTECHTRA
2629 TERMINAL BLVD.
MOUNTAIN VIEW
CA 94043 USA
PHONE 415/967-8818
TLX 345 545 INTECTRA MNTV

LIECHTENSTEIN
(SEE SWITZERLAND)

LUXEMBOURG
(SEE GERMANY)

NETHERLANDS
NIJKERK ELEKTRONIKA BV
DRENTESTRAAT 7 1083HK
AMERSTERDAM
HOLLAND
PHONE 020 462221
TLX 11625 NESCO NL

NEW ZEALAND
PROFESSIONAL ELECTRONICS LTD.
PO BOX 31-143
22A MILFORD ROAD
MILFORD, AUCKLAND 9, NEW ZEALAND
PHONE 46 94 50
TLX 791-21984 PROTON

NORWAY
HEFRO TEKNISK A/S
POST BOKS 6596 RODEZOKKEN
TRONDHEIMSVEIER 80
OSLO 5, NORWAY
PHONE 30 02 86
TLX 856-76205 HEFRO N

SINGAPORE
ROHM ELECTRONICS PTE. LTD.
140 BAYA LEBAR ROAD
#06-01103, A-Z BLDG.
SINGAPORE 1440
PHONE 65-745-9342
TLX 786-26648 ROHMS

SOUTH AFRICA
SOUTH CONTINENTAL DEVICES
RANDOVER HSE, SUITE 516
COR HENDRIK VERWOERD, DOVER RD.
RANDBURG, TRANSVALL, SO. AFRICA
PHONE 48 05 15
TLX 960 4-24849 SA

SEAMAX
80 GENTING LANE, #03-07 GENTING BLK
RUBY INDUSTRIAL COMPLEX
SINGAPORE 1334
PHONE 7476155
TLX RS51147 SEAMAX
FAX (065) 7447653

SPAIN
UNITRONICS, SA
PRINCESA, 1
MADRID 8, SPAIN
SPAIN
PHONE 242-52-04
TLX 831-46786 UTRON E

SWEDEN

AB BETOMA
DALVAGEN 12, BOX 1138
S-117 22 SOLNA
SWEDEN
PHONE 08-820280
TLX 19389 BETOMA(S)

SWITZERLAND

STOLZ AG
TAEFERNSTR. 15
CH-5405
BADEN-DAETTWILL, SWITZERLAND
PHONE 056 840151
TLX 82088 SAG CH

TAIWAN

SEA UNION
PO BOX 45-95 TAI PEI
ROOM 303, HUA-NAN BLDG.
NO. 162, CHANG AN EAST RD., 2ND SEC.
TAIPEI, TAIWAN, PEP. OF CHINA
PHONE 751-2063 OR 751-6856
TLX 24209 SEAUNION TAIPEI

UNITED KINGDOM

MICROCALL LTD.
THAME PARK ROAD
THAME, OXON 0X9 3XD
ENGLAND
PHONE 084-421-4505
TLX 83 7457 MEMEC G

ALL OTHER COUNTRIES

(CALL EXAR DIRECT)

REGIONAL SALES OFFICES

EXAR CORPORATION - Europe
ZILOG HOUSE
MOORBRIDGE ROAD
MAIDENHEAD, BERKS., ENGLAND
44-628-783066

EXAR CORPORATION
AUGUSTENSTRABE 115
D-8000 MUNCHEN 40
WEST GERMANY
089/52390320
TLX 522470
FAX 089-23035289

EXAR CORPORATION
Corporate Headquarters
750 PALOMAR AVENUE
SUNNYVALE, CA 94086
408/732-7970
TWX 910-339-9733
FAX 408-737-1635

EXAR

Authorized Distributors

ALABAMA

MARSHALL ELECTRONICS
3313 MEMORIAL PKWY., SO.
HUNTSVILLE, AL 35801
205/881-9235

RESISTICAP
11547-B S MEMORIAL PKWY.
HUNTSVILLE, AL 35815-0889
205/883-4270

RM ELECTRONICS
4902 UNIVERSITY SQUARE
HUNTSVILLE, AL 35805
205/852-1550

ALAKSA

(CALL EXAR DIRECT)

ARIZONA

BELL INDUSTRIES
1705 W. FOURTH ST.
TEMPE, AZ 85281
602/966-7800

MARSHALL ELECTRONICS
835 WEST 22ND ST.
TEMPE, AZ 85282
602/968-6181
TWX 910-950-0133

STERLING ELECTRONICS
3501 E. BROADWAY RD.
PHOENIX, AZ 85040
602/268-2121
TLX 667317 STERLING PHX
FAX 602-268-2121-286

WESTERN MICRO
7740 E. REDFIELD DR.
SCOTTSDALE, AZ 85260
602/948-4240

ARKANSAS

CARLTON-BATES
3600 W. 69TH ST.
LITTLE ROCK, AR 72219
501/562-9100

CALIFORNIA

A.V.E.D.
1582 PARKWAY LOOP, UNIT G
TUSTIN, CA 92680
714/259-8258

BELL INDUSTRIES
12322 MONARCH STREET
GARDEN GROVE, CA 92641
714/220-0681
TWX 910-596-2362

BELL INDUSTRIES
306 E. ALONDRA BLVD.
GARDENA, CA 92047
213/515-1800
TWX 910-346-6336

BELL INDUSTRIES
11812 SAN VINCENTE BLVD., #300
LOS ANGELES, CA 90049
213/826-6778

BELL INDUSTRIES
500 GIUSEPPE CT., STE. 6
ROSEVILLE, CA 95678
916/969-3100

BELL INDUSTRIES
1161 N. FAIROAKS AVE.
SUNNYVALE, CA 94086
408/734-8570
TWX 910-339-9378

BELL INDUSTRIES
7450 RONSON ROAD
SAN DIEGO, CA 92111
619/268-1277

BELL INDUSTRIES
1829 A DEHAVILLAND DR.
THOUSAND OAKS, CA 91320
805/499-6821
TWX 910-321-3799

DIPLOMAT ELECTRONICS
20151 BAHAMA STREET
CHATSWORTH, CA 91311
818/341-4411

DIPLOMAT ELECTRONICS
140 MCCORMICK AVE.
COSTA MESA, CA 92626
714/549-8401

DIPLOMAT ELECTRONICS
7564 TRADE STREET
SAN DIEGO, CA 92121
619/549-0145

DIPLOMAT ELECTRONICS
1310 KIFER ROAD.
SUNNYVALE, CA 94086
408/734-0204
TWX 910-379-0006

IEC
20600 PLUMMER ROAD
CHATSWORTH, CA 91311
818/998-2200
TWX 910-494-1923

IEC
#3A VANDERBILT
IRVINE, CA 92718
714/837-9960

MARSHALL ELECTRONICS
9710 DE SOTO AVE.
CHATSWORTH, CA 91311
818/407-4100

MARSHALL ELECTRONICS
9674 TELSTAR AVENUE
EL MONTE, CA 91731-3004
818/442-7204

MARSHALL ELECTRONICS
ONE MORGAN
IRVINE, CA 92718
714/458-5309

MARSHALL ELECTRONICS
3039 KILGORE AVE., SUITE 140
RANCHO CORDOVA, CA 95670
916/635-9700

MARSHALL ELECTRONICS
10105 CARROLL CANYON RD.
SAN DIEGO, CA 92131
619/578-9600

MARSHALL ELECTRONICS
336 LOS COCHES STREET
MILPITAS, CA 95035
408/943-4600

WESTERN MICROTECHNOLOGY
10040 BUBB ROAD
CUPERTINO, CA 95014
408/725-1664

ZEUS COMPONENTS, INC.
1130 HAWK CIRCLE
ANAHEIM, CA 92807
714/632-6880

COLORADO

DIPLOMAT ELECTRONICS
3974 YOUNGFIELD ST.
WHEATRIDGE, CO 80033
303/422-9229

BELL INDUSTRIES
8155 W. 48TH AVE.
WHEATRIDGE, CO 80033
303/424-1985
TWX 910-938-0393

MARSHALL ELECTRONICS
12351 N. GRANT
THORNTON, CO 80241
303/427-1818

CONNECTICUT

DIPLOMAT ELECTRONICS
52 FEDERAL ROAD
DANBURY, CT 06810
203/797-9674

J.V. ELECTRONICS
690 MAIN STREET
EAST HAVEN, CT 06512
203/469-2321

MARSHALL ELECTRONICS
20 STERLING DRIVE
WALLINGFORD, CT 06492
203/265-3822

RC COMPONENTS
SETTLERS INDUSTRIAL PARK
230 PEPES FARM ROAD
MILFORD, CT 06460
203/874-0006

DELAWARE
(SEE PENNSYLVANIA)

FLORIDA
BELL/GRAHAM ELECTRONICS
10810 72ND ST., N., STE. 201
LARGO, FL 33543
813/541-4434

DIPLOMAT ELECTRONICS
2120 CALUMET STREET
CLEARWATER, FL 33575
813/443-4514

DIPLOMAT ELECTRONICS
1300 NW 65TH PLACE
FT. LAUDERDALE, FL 33309
305/974-8700

FUTURE ELECTRONICS
2073 RANGE ROAD
CLEARWATER, FL 33575
813/596-8295

MARSHALL ELECTRONICS
1001 NW 62ND ST., STE 306D
FT. LAUDERDALE, FL 33309
305/928-0661

MARSHALL ELECTRONICS
4205 34TH ST., SW
ORLANDO, FL 32811
305/841-1878

REPTRON ELECTRONICS
3320 NW 53RD ST., STE. 206
FT. LAURDERDALE, FL 33309
305/735-1112

REPTRON
13700 MC CORMICK DR.
TAMPA, FL 33625
813/855-4656

GEORGIA
BELL/GRAHAM ELECTRONICS
6690 JONES MILL CT., UNIT C
NORCROSS, GA 30092
404/662-0923

MARSHALL ELECTRONICS
4350 J INTERNATIONAL BLVD.
NORCROSS, GA 30093
404/923-5750

PAN AMERICAN
RTE.7, SHADY GROVE RD.
COMMING, GA 30130
404/577-2144

PREHLER ELECTRONICS
4400 C BANKERS CIRCLE
ATLANTA, GA 30360
404/447-5540
800/241-0940 TOLL FREE

IDAHO
(SEE WASHINGTON)

ILLINOIS
BELL INDUSTRIES
515 BUSSE AVENUE
ELK GROVE VILLAGE, IL 60007
312/640-1910
TWX 910-223-4519

DIPLOMAT ELECTRONICS
1071 JUDSTON STREET
BENSENVILLE, IL 60106
312/595-1000

GBL-GOULD
610 BONNIE LANE
ELK GROVE VILLAGE, IL 60007
312/593-3220

IEC / INTERCOMP
2200 STRONGTON AVE., STE. 210
HOFFMAN ESTATES, IL 60695
312/843-2040

MARSHALL ELECTRONICS
1261 WILEY RD., UNIT F
SCHAUMBURG, IL 60195
312/490-0155

PREHLER ELECTRONICS
2300 N. KILBOURN AVE.
CHICAGO, IL 60639
312/384-6010
800/621-4177 TOLL FREE

REPTRON
1000 E. STATE PARK, SUITE K
SCHAUMBURG, IL 60195
312/882-1700

RM ELECTRONICS
180 CROSSEN
ELK GROVE VILLAGE, IL 60007
312/932-5150
TWX 910-651-3245

INDIANA
ALTEX
12774 N. MERIDIAN
CARMEL, IN 46032
317/848-1323
TWX 810-341-3481

BELL/GRAHAM ELECTRONICS
133 S. PENNSYLVANIA STREET
INDIANAPOLIS, IN 46204
317/634-8202
TWX 810-341-3481

BELL/GRAHAM ELECTRONICS
3343 W. WASHINGTON BLVD.
FORT WAYNE, IN 46803
219/423-3422

BELL/GRAHAM ELECTRONICS
408 NORTH STREET
LAFAYETTE, IN 47902
317/423-5564

MARSHALL ELECTRONICS
6990 CORPORATE DRIVE
INDIANAPOLIS, IN 46278
717/786-2774

PREHLER ELECTRONICS
6060 CASTLEWAY WEST
INDIANAPOLIS, IN 46250
317/841-0018

RM ELECTRONICS
7031 CORPORATE CIRCLE DR.
INDIANAPOLIS, IN 46278
317/291-7110

IOWA
BELL INDUSTRIES
1221 PARK PLACE, NE
CEDAR RAPIDS, IA 52402
319/395-0730

DEECO, INC.
2500 16TH AVE., SW
CEDAR RAPIDS, IA 52406
319/365-7551
TWX 910-525-1331

KANSAS
MARSHALL ELECTRONICS
8321 MELROSE DRIVE
LENEXA, KS 66214
913/492-3121

KENTUCKY
(SEE INDIANA)

LOUISIANA
(SEE TEXAS)

MAINE
(SEE MASSACHUSETTS)

MARYLAND
DIPLOMAT ELECTRONICS
9150 RUMSEY RD., STE. A-6
COLUMBIA, MD 21045
301/995-1226

MARSHALL ELECTRONICS
8445 HELGERMAN COURT
GAITHERSBURG, MD 20877
301/840-9450

VANTAGE ELECTRONICS
9625 R OAKLAND MILLS RD.
COLUMBIA, MD 21045
301/720-5100

MASSACHUSETTS
BELL INDUSTRIES
329 WASHINGTON ST., #103
WOBURN, MA 01801
617/932-0577

DIPLOMAT ELECTRONICS
17 E STERLING ROAD
BILLERICA, MA 01862
617/667-4670

GERBER
128 CARNEGIE ROW
NORWOOD, MA 02061
617/329-2400
TWX 710-336-1987

MARSHALL ELECTRONICS
ONE WILSHIRE ROAD
BURLINGTON, MA 01803
617/272-8200

RC COMPONENTS
222 ANDOVER STREET
WILMINGTON, MA 01887
617/657-4310
TWX 710-347-1743

MICHIGAN
BELL/GRAHAM ELECTRONICS
814 PHOENIX DRIVE
ANN ARBOR, MI 48104
313/971-9093

MARSHALL ELECTRONICS
13760 MERRIMAN RD.
LIVONIA, MI 48150
313/525-5850

PREHLER ELECTRONICS
20770 ORCHARD LAKE ROAD
FARMINGTON HILLS, MI 48024
313/473-7200
800/336-1406 TOLL FREE
800/321-5982 OUTSIDE MI

RM ELECTRONICS
4310 R.B. CHAFFEE MEMORIAL DR.
GRAND RAPIDS, MI 49508
6I16/531-9300
TWX 810-273-8779

REPTRON ELECTRONICS
34404 GLENDALE ROAD
LIVONIA, MI 48150
313/525-2700

MINNESOTA
DIPLOMAT ELECTRONICS
14920 29TH AVENUE, NO.
PLYMOUTH, MN 55441
612/559-2500

MARSHALL ELECTRONICS
3800 ANNAPOLIS LANE
PLYMOUTH, MN 55441
612/559-2211

MERIT ELECTRONICS
2525 NEVADA AVE., STE. 210
MINNEAPOLIS, MN 55427
612/546-5383

MISSISSIPPI
(SEE GEORGIA)

MISSOURI
OLIVE ELECTRONICS
9910 PAGE BOULEVARD
ST. LOUIS, MO 63132
314/426-4500
TWX 910-763-0720

MONTANA
(CALL EXAR DIRECT)

NEBRASKA
(SEE MISSOURI)

NEVADA
(SEE CALIFORNIA)

NEW HAMPSHIRE
(SEE MASSACHUSETTS)

NEW JERSEY
DIPLOMAT ELECTRONICS
490 S. RIVER VIEW DR.
TOTOWA, NJ 07512
201/785-1830

GCI/GENERAL COMPONENTS INC.
245 D CLIFFTON AVENUE
WEST BERLIN, NJ 08091
609/768-6767

NU HORIZONS
258A ROUTE 46
FAIRFIELD, NJ 07006
201/882-8300

MARSHALL ELECTRONICS
101 FAIRFIELD ROAD
FAIRFIELD, NJ 07006
201/882-0320

MARSHALL ELECTRONICS
158 GAITHER DRIVE
MT. LAUREL, NJ 08054
609/234-9100 (NJ)

NEW MEXICO
BELL INDUSTRIES
11728 LINN, NE
ALBUQUERQUE, NM 87123
505/292-2700
TWX 910-989-0625

BETATRON
2825 B BROADBEND PKWY., NE
ALBUQUERQUE, NM 87123
505/344-2318

NEW YORK
DIPLOMAT ELECTRONICS
4610 WETZEL ROAD
LIVERPOOL, NY 13088
315/652-5000

DIPLOMAT ELECTRONICS
110 MARCUS DRIVE
MELVILLE, NY 11747
516/454-6400

JACO
145 OSER AVENUE
HAUPPAUGE, NY 11787
516/2734-5500
TWX 510-227-6232

MARSHALL ELECTRONICS
129 BROWN ST.
JOHNSON CITY, NY 13790
607/798-1411

MARSHALL ELECTRONICS
275 OSER AVENUE
HAUPPAUGE, LI, NY 11788
516/273-2424

MARSHALL ELECTRONICS
1280 SCOTTSVILLE ROAD
ROCHESTER, NY 14624
716/235-7620

NU HORIZONS
60000 NEW HORIZONS BLVD.
N. AMITYVILLE, NY 11701
516/226-6000

S.A.I.
105 BAYLISS ROAD
MELVILLE, NY 11747
516/293-2710

ZEUS COMPONENTS, INC.
100 MIDLAND AVENUE
PORTCHESTER, NY 10573
914/937-7400
TWX 710-567-1248

NORTH CAROLINA
MARSHALL ELECTRONICS
5221 NORTH BOULEVARD
RALEIGH, NC 27604
919/878-9882

OHIO
BELL INDUSTRIES
444 WINDSOR PARK DRIVE
DAYTON, OHIO 45459
513/435-8660
TWX 810-461-2860

BELL INDUSTRIES
118 WESTPARK ROAD
DAYTON, OH 45459
513/434-8231

MARSHALL ELECTRONICS
6212 EXECUTIVE BLVD.
DAYTON, OHIO 45424
513/236-8088

MARSHALL ELECTRONICS
5905-B HARPER ROAD
SOLON, OH 44139
216/248-1788

PREHLER ELECTRONICS
17991 ENGLEWOOD STREET
MIDDLEBURG HEIGHTS, OH 44130
216/243-5510
800/824-9319 TOLL FREE
800/321-0178 OUTSIDE OH

REPTRON ELECTRONICS
404 E. WILSON BRIDGE RD.
WORTHINGTON, OH 43805
614/436-6675

OKLAHOMA
QUALITY COMPONENTS
9934 E. 21ST ST., S.
TULSA, OK 74128
918/664-8812

RADIO, INC.
1000 S. MAIN STREET
TULSA, OK 74119
918/587-9123

OREGON
BELL INDUSTRIES
6024 SW JEAN ROAD
LAKE OSWEGO, OR 97034
503/241-4115
TWX 910-455-8177

MARSHALL ELECTRONICS
8333 SW CIRRUS AVENUE
BEAVERTON, OR 97005
503/644-5050

RADAR ELECTRIC CO., INC.
704 SE WASHINGTON
PORTLAND, OR 97214
503/232-3404

WESTERN MICROTECHNOLOGY
13770 SW 24TH STREET
BEAVERTON, OR 97005
503/641-9312

PENNSYLVANIA
ADVACOM
5620 WEST ROAD
MCKEAN, PA 16426
814/476-7774

RHODE ISLAND
(SEE MASSACHUSETTS)

SOUTH CAROLINA
(CALL EXAR DIRECT)

TENNESSEE
BELL/GRAHAM ELECTRONICS
230 GREAT CIRCLE RD., #124
NASHVILLE, TN 37228

TEXAS
BELL INDUSTRIES
9 HIGHLAND
RICHARDSON, TX 95081
214/744-2510

DIPLOMAT ELECTRONICS
3410 MID COURT, SUITE 128
CARROLLTON, TX 75006
214/980-1888

DIPLOMAT ELECTRONICS
2201 DENTON DR., STE. 104
AUSTIN, TX 78758
512/836-8707

INTERNATIONAL ELECTRONICS
10937 PELICANO DRIVE
EL PASO, TX 79935
915/598-3406

MARSHALL ELECTRONICS
8705 SHOAL CREEK, SUITE 202
AUSTIN, TX 78758
512/458-5654

MARSHALL ELECTRONICS
2045 CHENAULT
CARROLLTON, TX 75006
214/770-0602

MARSHALL ELECTRONICS
3698 WESTCHASE DRIVE
HOUSTON, TX 77042
713/789-6600

QUALITY COMPONENTS
4257 KELLWAY CIRCLE
ADDISON, TX 75001
215/733-4300

QUALITY COMPONENTS
2120 M. BRAKER LANE
AUSTIN, TX 78758
512/835-0220

QUALITY COMPONENTS
1005 INDUSTRIAL BLVD.
SUGARLAND, TX 77478
713/491-2255
TWX 910-925-5686

UTAH
BELL INDUSTRIES
3639 W. 2150 SO.
SALT LAKE CITY, UT 84120
801/972-6969

DIPLOMAT ELECTRONICS
3007 SW TEMPLE
SALT LAKE CITY, UT 84115
801/486-4134

MARSHALL ELECTRONICS
3501 SOUTH MAIN STREET
SALT LAKE CITY, UT 84115
801/261-0901

VERMONT
(SEE MASSACHUSETTS)

VIRGINIA
(SEE MARYLAND)

WASHINGTON
BELL INDUSTRIES
1900 132ND AVE., NE
BELLEVUE, WA 98005
206/747-1515

DIPLOMAT ELECTRONICS
541 INDUSTRY DRIVE
SEATTLE, WA 98188
206/575-1633

IEC
1750 124TH AVE., SUITE J
BELLEVUE, WA 98005
206/455-2727

MARSHALL ELECTRONICS
14102 NE 21ST STREET
BELLEVUE, WA 98007
206/747-9100

RADAR ELECTRIC CO., INC.
168 WESTERN AVE., W
SEATTLE, WA 98119
206/282-2511
TWX 910-444-2052

WESTERN MICROTECHNOLOGY
14636 NE 95TH STREET
REDMOND, WA 98052
206/881-6737

WISCONSIN
BELL INDUSTRIES
W 227 N 913 W MOUND AVE.
WAUKESHA, WI 53186
414/547-8879

MARSHALL ELECTRONICS
235 N. EXECUTIVE DR.
BROOKFIELD, WI 53005
414/797-8400

RM ELECTRONICS
2626 S. 162 ND STR.
BERLIN, WI 53151

TAYLOR ELECTRIC CO.
1000 W. DONGES BAY RD.
MEQUON, WI 53091
414/241-4321
TWX 910-262-3414

WYOMING
(SEE COLORADO)

CANADA
FUTURE ELECTRONICS
237 HYMUS BLVD.
PT. CLAIRE, MONTREAL
CANADA H9R 5C7
514/694-7710

INTEK ELECTRONICS LTD.
6830 BURLINGTON AVE.T.
BURNABY, B.C.
CANADA V5J 4H1
604/435-1777
TLX 04-356635

INTEK ELECTRONICS LTD.
4616 99TH STREET
EDMONTON, ALBERTA
CANADA T6E 5H5
403/437-2755

L.A. VARAH
504 A IROQUOIS SHORE DRIVE
OAKVILLE, ONTARIO
CANADA L6H 3K4
416/842-8484
TWX 06-982397

L.A. VARAH
1-1832 KING EDWARD ST.
WINNEPEG, MANITOBA
CANADA R2R 0N1
204/633-6190

L.A. VARAH
6420 6A STREET SE
CALGARY, ALBERTA
CANADA T2H 2B7
403/255-9550

L.A. VARAH
2077 ALBERTA ST.
VANCOUVER, BRITISH COLUMBIA
CANADA V5Y 1C4
604/873-3211

R.A.E. INDUSTRIAL ELECTRONICS
3455 GARDNER CT.
BURNABY, B.C.
CANADA V5G 4J7
604/291-8866
TLX 0435653

R.A.E. INDUSTRIAL ELECTRONICS
11680 - 170 STREET
EDMONTON, ALBERTA
CANADA T5S 1J7
403/451-4001
TLX 0372653

R.A.E.
501-45A STREET EAST
SASKATOON, SASKATECHEWAN
CANADA S7K 0W6
306/933-2888
TLX 0742825

R.A.E.
760 CENTURY STREET
WINNIPEG, MANITOBA,
CANADA R3H 0M1
204/786-8401
TLX 0757622

R.A.E.
500 NORFINCH DRIVE
DOWNSVIEW, ONTARIO
CANADA M3N 1Y4
416/736-1588
TLX 06527405

R.A.E.
15 MT. ROYAL BLVD.
MONCTON, NEW BRUNSWICK
CANADA E1E 2T9
506/855-2200
TLX 0142889

R.A.E.
#103 - 11 MORRIS DR.
DARTMOUTH, NOVA SCOTIA
CANADA 1M2
902/465-2350
TLX 01931563

REGIONAL DISTRIBUTION OFFICES

EXAR CORPORATION
1787 VETERANS MEMORIAL HWY.
CENTRAL ISLIP, NY 11772
516/582-8983

EXAR CORPORATION
Corporate Headquarters
750 PALOMAR AVENUE
SUNNYVALE, CA 94086
408/732-7970
TWX 910-339-9233
FAX 408-737-1635

- Notes -

- Notes -

- Notes -

- Notes -

- Notes -

- Notes -

- Notes -

- Notes -

EXAR Corporation – 750 Palomar Avenue, Sunnyvale, CA 94086